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CONSERVATION OF THE OVARIES AND THE UTERUS IN OPERATIVE PROCEDURES UPON THE UTERINE ADNEXÆ

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IS it possible in some of the operations necessary for old pelvic suppurative processes to substitute for utero-adnexal castration the simple removal of infected and suppurated tubes, thus saving the ovaries and the uterus? This question I am going to discuss. My conclusions are based upon twenty-eight cases, in which I have practiced conservatism. These cases have occurred in the last five years.

The study of this question is timely. It necessitated the solution of other questions concerning the therapy of inflammations of the uterine adnexæ. First, instead of operating in the acute stage, we had to learn the value of operating after the subsidence of all acute inflammatory symptoms. This gives nature time to restore the organs as nearly as possible to their anatomical integrity. Second, it was necessary that abdominal surgery should have obtained aseptic perfection, in order that adhesions might not form.

The secondary operations that we have been compelled to do have demonstrated that we can expect a *restitutio ad integrum*, even though the small pelvis be badly infected.

The first operation was performed in 1900. The patient was a Canadian, with a bilateral pyosalpinx, who wished to save as much of the genitalia as possible, and to keep the menstrual function. To do that the two ovaries and the uterus had to be saved. I operated with Dr. Maguire, of San Francisco. After the abdominal incision, I found two pus tubes with some adhesions. They were removed without rupture, the uterine stumps were cauterized, and the two ovaries were retained, although one was slightly sclerosed. The patient recovered, continued to menstruate, and ceased to have painful symptoms.

The following objection to this operation suggested itself to me. Removing the tube and keeping the ovaries and the uterus, is to keep two organs that are certainly diseased, and is to compel ovulation to take place into the abdominal cavity. Is this without inconvenience? Let me make myself clear. I am only considering the conservation of sclero-cystic ovaries, and not the conservation of ovaries that have suppurated.

The symptoms dependent upon sclero-cystic ovaries have been exaggerated. I feel satisfied that the diagnosis of sclero-cystic ovaries has concealed many diagnostic mistakes, and has justified many useless operations. I have seen, as you have seen, so many of these ovaries which occasioned no symptoms at all. I believe that these sclero-cystic ovaries are more often dependent upon disturbances of ovarian vascularization than upon infection. Hence, just as the majority among you, I remove them only in exceptional instances.

The uterus that was infected, but which, at the time of the operation, is partially cured is kept. We thought for a time that this infected uterus might be the starting-point of new symptoms. That is why many operators supplemented the removal of the adnexæ with the removal of the uterus.

Upon studying the question, one sees that many of these painful uteri, after the removal of the adnexæ, owe their symptoms to the persistence of an infected stump left in the cornu of the uterus. I will show you that nothing is easier than the removal of this infected stump.

There is one remaining objection. It is this: The uterine mucosa being infected can give rise to the complications of metritis, and can cause hemorrhages. It is easy to meet these complications by curettage and by local measures.

It is repugnant to me to remove both tubes and ovaries in a young woman. For a long time I persisted in cases of salpingitis, in doing a unilateral salpingectomy. This operation has given me many disappointments. I have ceased to count the cases in which I have had to operate a second time to remove the opposite tube. The integrity of the peritoneum in these cases showed me that the infection of the opposite tube had taken place by the tubal mucosa, and was not at all dependent upon the uterus. I have operated, in many cases, with badly diseased pus tubes with many adhesions, and, despite the inflammatory and suppurative processes, I have noticed that the true pelvis became covered with peritoneum.

The conservation of the ovaries without permeability of the tubes has this necessary consequence—ovulation takes place into the peritoneal cavity. Is this detrimental? Pathological anatomy answers this question. I have seen a woman with an imperforate uterus having normal ovaries—normal as to shape, normal as to size, and in corpora lutei—that is, ovaries functionating properly, without evidences of peritubal lesions. In the ablation of fibromata, in which I have always been equally conservative—I always preserve both ovaries. I have never had cause to complain. The ovum that falls into the peritoneal cavity leaves a small aseptic cyst, or it is absorbed; hence, from that point of view, we have nothing to fear.

One question remains. The ovary that we leave in place—will it continue to live? Will it continue to functionate? Is the operation that I propose like unilateral castration, conservative in name only?

The fact that all patients in this series have continued to menstruate answers this affirmatively. But I wanted more, I wanted an anatomical proof, and you will see at once, after I have described to you my operative technic, that the vascularization of the ovaries is perfect after the total ablation of the tube.

This is my technic: It is so simple that I apologize for describing it. I attempt, as much as possible, to attack the tube from the uterus toward the fimbriæ. As an example, take a closed tube containing sero-pus. I place forceps upon the uterine end of the tube, and another forceps without that. I incise between the two, and isolate the uterine angle with its forceps by the aid of a compress. Then I incise the broad ligament immediately below the body of the tube, thereby removing the tube up to its fimbriæ, carefully isolating the ovary from its salpingo-peritoneal adhesions. I insist upon the necessity of perfect hemostasis. The edges of the broad ligament bleed, and bleed freely. My friend and colleague, Rieffel, has shown that the blood-vessels that supply the tube are largely independent of those of the ovary, and they are also independent of each other. Altogether, they form a comb, the teeth of which lose themselves in the tube. I do not believe that you can put a ligature *en masse*, or a continuous ligature to stop the hemorrhage. I also wish to caution you against hemorrhage from the uterine angle and from the tubo-ovarian ligament. Primary and permanent hemostasis must be perfect.

I now assume that you have treated the second tube like the first. Your hemostasis is thorough on both sides. You still have the uterine angles and the intra-uterine course of both tubes. I destroy them with the thermocautery. Then I close the angles with deep catgut sutures, overlapped with Lembert sutures. In this way the uterine mucosa has been well isolated, and we feel certain that it will not infect the neighboring tissues. This much completed, we have, in the center, a uterus, and, laterally, the superior margins of the broad ligaments covered with peritoneum.

You have no hemorrhage on either side from the ovaries. You will see that both ovarian glands have a tendency to fall behind the uterus into the cul-de-sac of Douglas.

Almost always I fix one extremity of the tubo-ovarian ligament to the round ligament. I then have a median uterus with two lateral ovaries, resembling the two tonsillar fossæ. I close the abdomen in two layers with catgut and unite the skin with hooks.

Before closing the abdominal wall, I satisfy myself as to the hemostasis and as to the absolute integrity of the small pelvis. For the description of this technic, I have taken a simple case. However, I am talking to surgeons, and it is not necessary to speak about little details, such as puncturing cystic tubes that are of excessive size, such as beginning the separation of the tube by its fimbriated extremity—the separation of adhesions is more easily affected in that way—such as resection of the omentum, etc., etc. All these things are familiar to you—you do them every day, and each one of you can adopt the line of conduct that the individual case requires.

These are my statistics: I have operated twenty-eight times. The ages of the patients vary from twenty-one to forty-one years. The tubal lesions noted at the time of the operation were: Salpingitis, with the exception of one case, was always bi-lateral. The lesions were not always the same on both sides. Twenty of the cases were suppurative salpingitis, four hematosalpinx, eight cystic, ten interstitial, and two tubercular. The ovaries were apparently sound in nineteen cases, somewhat sclerocystic in nine cases. The uterus presented the following appearances: Retroflexed, five times; in normal position, but slightly anteflexed, twenty-three times. In all cases it was infected. When everything leads you to think that you have a fungus metritis, before opening the abdominal cavity curette. I omitted to do this in one case, which necessitated post-operative curettement.

I will consider successively the immediate operative results, the consecutive results, and then the late results in those patients whom I have been able to keep under my observation.

The operative mortality has been $3\frac{1}{2}$ per cent —one death in the twenty-eight cases. My patient died of a late septicæmia, due to an effusion of blood in the Douglas cul-de-sac, which suppurated, and was followed by peritonitis.

Consecutive accidents admit of two classifications: the state of the patients after the operations, and the incidents of their recovery. In the days that follow the operation, the patients are certainly in a less perfect condition than if they had been subjected to a double castration. They have, at times, some pain and some malaise that is not observed after hysterectomies.

The two post-operative accidents that I have observed have had the same origin and the same termination. I cannot dwell too long upon them. On the fourth and fifth day, the patients had a slight elevation of temperature, some pain, some nausea, some vomiting. Vaginal touch showed that there was an induration of the posterior cul-de-sac. In these two cases I thought I was dealing with an effusion, hemorrhagic in nature, in the Douglas cul-de-sac. In both cases I incised the posterior cul-de-sac; relief was immediate, cure was complete. I mention this fact because, even when one is forewarned, hemostasis may not be perfect, and you must consider the possibility of hemorrhage whenever you are in doubt as to the perfection of your hemostasis.

The definite results of this operation are of the greatest importance. Unfortunately, our hospital patients are not always at our disposal, and I have not been able to trace them all. Of my twenty-eight patients, I have seen fifteen, and I omit from consideration two cases, not enough time having elapsed in these two since the time of the intervention. Thus we have fifteen patients. One suffered some pain despite her regular menses, but she had a tubercular salpingitis, diagnosed by inspection and by the microscope by the head of my laboratory, M. Mauté. I performed upon her an abdominal pan-hysterectomy, and in the course of the operation I saw that the uterus was in place, the left ovary was bound to it by a distinct ligament, the right ovary had been removed, the orifices of the tube were closed, covered with peritoneum, but the whole surface presented tuberculous granulations. One of the patients whom I operated upon with Dr. Dordel, had fungous metritis, and had to be curetted. She

is now in a perfect state. In her case I had removed a hematosalpinx on one side, and pyosalpinx on the other. With the exception of these two women, all of my patients have been remarkably benefited by the intervention.

I have examined them with two things in mind, (a) functional symptoms, (b) the presence of lesions, determinable by palpation. The regularity of the menses after the second month, their normal duration, their painlessness, are constant facts which I have been able to find in all cases, whether I had been dealing with septic or aseptic cases, whether few or many adhesions were present. Of these women who complained of pain, in not one was the pain severe enough to detain the sufferer from her work. In three cases pain was present when patients overfatigued themselves, but these women were satisfied with their condition, and they came to see me only upon my written request. Of these three cases, one had been relieved of two large pus tubes the size of a fist. The other had a double pyosalpinx adherent to the gut, to the omentum, and to the small pelvis. The third had, in addition, been subjected to colpotomy, and was an enteroptosic. She also complained of gastric symptoms.

Vaginal examination, combined with abdominal palpation, permits us to determine the state of the uterus and the ovaries. The uterus was generally anteflexed—in one case it was movable—but its volume had diminished—in a few of my cases markedly so, as that in which I ultimately did a hysterectomy for the tubercular lesion. On the other hand, it had increased in size in the woman who had fungous metritis, and of whom I have spoken as having curetted after a previous operation upon the tubes.

In a few of my cases the ovaries could not be palpated. The lateral fornices were painless. Most always, however, by pressing the uterine cornua it was possible to excite ovarian pains.

Such are the results that I have obtained in my attempts to save the ovaries and the uterus in operations upon the uterine adnexæ. It seems to me that these results justify their continuance. Further experience will permit us to formulate the indications of this intervention. This paper has neither the privilege nor the desire to define these indications. It seems, however, that tubes, the contents of which are quiescent, the ends of which have for long been closed, that have few adhesions, that have ovaries that are not atrophied, with a uterus that is only slightly increased in size, these, when occurring in a young woman without ptosis, without neuropathic stigmata, afford a suitable indication for this conservative operative intervention.

An abscess with inflammation of the uterus, would justify double utero-adnexal castration.

These are only general considerations which experience can and will modify. I consider the conservation of the organs at the same time that we secure the disappearance of the symptoms of which they are the seat, one of the characteristics of modern surgery. In my work upon myomectomies, I have attempted to save a few uteri, and I renew to-day my plea for the saving of the ovarian glands in certain adnexial diseases.

SUPERNUMERARY THYROID AT BASE OF TONGUE

By

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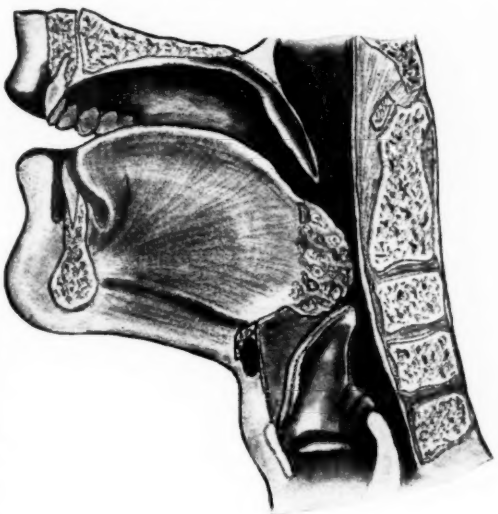
BENIGN tumors of the tongue are of so rare occurrence, that the following case seems worth reporting.

K. B. Female. Aet. eighteen years, entered Lakeside Hospital, Oct. 26, 1903. Her family and personal history were negative. She was anæmic and delicate in appearance. Three years before a physician had examined her throat on account of a complaint of chronic catarrh. He then noticed an enlargement on the dorsum of the tongue.

On admission to the hospital the following history was obtained. The patient complained of difficulty in speaking, which had been gradually increasing for three years. During the past four months there had been some difficulty in swallowing, and on exertion respiration was impeded.

Examination by Dr. Ingersoll was as follows: The nose and nasopharynx were normal. The base of the tongue was covered by a hemispherical shaped tumor, about four centimeters in diameter, projecting backward from the base of the tongue until it touched the posterior pharyngeal wall. The covering of the tumor appeared to be the normal tissue at the base of the tongue and was not inflamed. The epiglottis and the larynx were completely hidden by the tumor, which was firm and moved only with the tongue. There was no pain referable to it and no glandular enlargement.

Operation by Dr. Allen. The growth was removed Oct. 28, 1903. Chloroform anæsthesia was employed and the patient was placed in the dorsal position with hanging head. It was decided to enucleate the tumor if possible without any external incision or division of bone, in order to avoid disfigurement. The tongue was seized with forceps and drawn as far forward as possible. The fingers of the operator could then be hooked behind the tumor, drawing it forcibly forward, so as to bring it nearly to the line of the teeth. A small incision was made at the base of the tumor, along its anterior margin. This caused very slight hemorrhage. The fingers were then carried through the incision, below the tumor, separating it from its bed in the dorsum of the tongue. Since no appreciable hemorrhage occurred it was thought the lateral attachments might safely be separated. This separation was begun upon the left side. On cutting through the mucous capsule on this side there was a very profuse flow of blood, so copious as to threaten asphyxiation on the one hand, and a fatal hemorrhage on the other. The necessity for haste left no other possibility than instantly to divide the remaining attachments



Accessory thyroid gland upon dorsal surface of tongue. Drawing by J. M. Ingersoll.

and pack the cavity with gauze. While this decreased the flow of blood it by no means controlled it. Since the tissues on the left side of the tongue had been divided by a clean cut of the scissors, it was thought that ligature of the lingual artery on this side might control the hemorrhage. Accordingly, the artery was quickly ligated through an external incision, the pressure of gauze in the wound being continued. By these combined means hemorrhage was controlled. The patient was thoroughly exsanguinated and in collapse.

An intravenous infusion of 500 c.c. normal salt solution was given at once, and 1,000 c.c. were given about three hours later.

About two hours after the operation the patient's breathing was so embarrassed, doubtless due to the large amount of gauze packing, that it was necessary to perform a tracheotomy. With the removal of the gauze packing, two days after the operation, the patient improved rapidly and was dismissed from the hospital cured, all wounds healed, about two weeks after the operation.

The operation is reported thus at length to show the dangers incident to hemorrhage in the operation and the necessity of adopting means to avoid it. This might be accomplished by the application of clamps to the sides of the tumor before the lateral attachments of the tumor were divided. Doubtless ligature of the lingual arteries would be of assistance. Division of the jaw in the median line and separation of the tongue from the horizontal ramus by means of an external opening below the jaw and at the side would give better access to the tumor and enable the operator to control hemorrhage. All these means have, however, the disadvantage of causing disfigurement. Although the operation was successful the hemorrhage attending it was alarming.

Pathological Report, by Dr. Ludlow

Gross Description. The mass from the base of the tongue is four centimeters in greatest diameter, and resembles an egg in shape, with its long axis antero-posterior. It is somewhat flattened on its lower surface and the inferior portion is somewhat more blunt than the superior. The dorsal surface of the tumor shows mucous covering which presents numerous fine folds. Blood vessels are very numerous beneath this mucous membrane. Some of the muscular tissue of the tongue was removed with the tumor.

On section the tumor seemed to be distinctly encapsulated and divided into three very distinct lobes by trabeculæ of connective tissue. The inferior lobe is largest, and contains a cavity one-half cm. in diameter, filled with a dark bloody fluid. A smaller cavity is found in the middle lobe and a still smaller one in the superior lobe. The cut surface presents a yellowish-white appearance and shows numerous red areas the size of a pin's head. The tumor as a whole is rather soft and cuts easily. It resembles glandular tissue. A lymph gland removed from the incision made in ligating the left lingual artery is rather firm and normal in appearance.

Sections were taken from the tumor mass through the mucosa and underlying tissue and from different portions of the tumor. Both the celloidin and paraffine methods were used.

Section A. Through mucous membrane and tumor, showing only small portion of tumor. The surface of the section is covered by squamous epithelium, presents a wavy line which in some places is projected into distinct papillæ. The outer layers of epithelium are much flattened and stain a deep pink, while toward the base the cells are more ovoid in shape and take a blue stain. The papillæ are filiform in character. The tunica propria and sub-mucosa consist of connective tissue and numerous elastic fibers which form the support for large numbers of glands. These glands are of the branched tubular type. The walls of the tubules consist of a structureless membrana propria and gland cells; the latter are broad columnar elements, possessing a firm cell membrane and showing on deep blue staining small oval nuclei, pressed flat against the cell wall, thus presenting a picture of mucous glands loaded with secretion. In addition to the connective tissue, many bands of muscular fibres are found disposed in different planes, and thus appear in cross, longitudinal, and oblique section. The muscle is striated and the fibres interlace. The veins and arterioles show marked congestion. The tumor lying

SECTION A.

beneath the muscle fibres is surrounded by a dense fibrous capsule which sends down large trabeculæ from which a smaller net-work of connective tissue spreads throughout the remainder of the section. This framework forms support for a large number of gland tubules and in many places shows a hæmorrhagic infiltration. The tubules differ greatly in diameter and are lined by a simple layer of cubical epithelial cells. The nuclei are oval in shape, stain a deep blue and are situated near the center of the cell. The tubules appear in cross and oblique section; the latter being cut on the tangent, show the tubules apparently filled with epithelium. The contents of many of the tubules consists of a deep pink staining, homogeneous material, colloid substance, which is also found in the lymph spaces. Other tubules are filled with red blood cells.

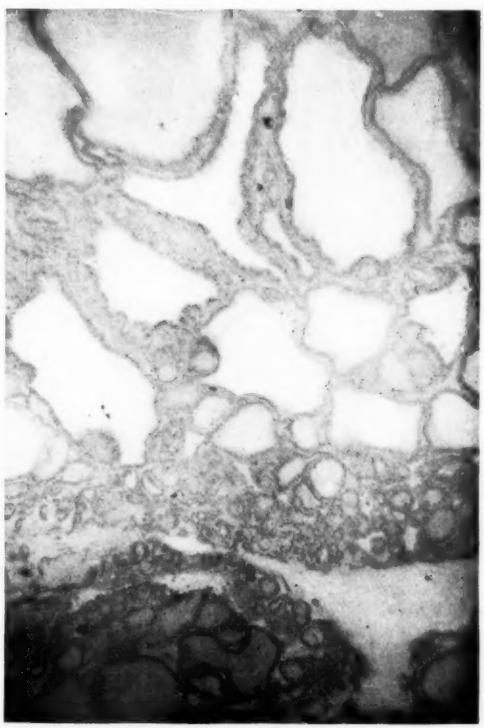
The blood vessels are very numerous and break up into capillaries that form a net-work about the tubules. This structure corresponds in every particular with that of the thyroid gland.

Section B. This section was taken through a deep portion of the tumor. The main portion of the section presents an appearance similar to that described in Section A. In one portion of the section the tubules are greatly dilated and filled with colloid material, but otherwise the section presents nothing additional to the above.

A lymph gland taken from the incision below the jaw on the left side is normal in appearance.

Supernumerary thyroid and gland tissue may occur in different portions of the body. One of the favorite positions is at the base of the tongue in the region of the foramen cæcum. The researches of His, made on very young human embryos, have enabled the tract extending from the foramen cæcum to the pyramidal lobe of the thyroid gland to be fully traced. This has proved of great service in explaining the occurrence of cysts and tumors in this region.

Hickman in 1868-9 described a congenital tumor of the tongue extending from the cir-



SECTION B

cumvallate papillæ nearly to the epiglottis, and deeply into the tongue which caused death by suffocation sixteen hours after birth. The tumor was described at that time as consisting of hypertrophy of racemose glandular structures with connective tissue and blood vessels.

Bernays, in October, 1888, St. Louis Medical and Surgical Journal, reported a case of a supernumerary thyroid situated at the base of the tongue. In April of the following year, R. Wolf, of Hamburg, reported a similar case.

In 1890 Butlin described two cases of tumors in the portion of the foramen cæcum, and gave drawings of the miscroscopic sections. They would formerly have been described as adenomata; but in accordance with the opinion expressed by Bernays and Bland Sutton, they were later thought to consist of thyroid gland tissue.

Winslow, of Baltimore, American Medicine, Dec. 13, 1902, records thirty cases of accessory thyroids and in addition reports a case occurring in his own service. The case reported in this article presents a striking similarity to Winslow's case, both in the clinical history and pathological findings.[1]

On Jan. 7, 1905, a letter received from the patient whose case is reported above states that her throat causes her no trouble. She states, however, that the left side of her tongue seems slightly paralyzed.

[1] For a bibliography the reader is referred to Winslow's excellent article above mentioned.

APPENDICITIS: THE EARLIEST AND COMPLETE REMOVAL OF THE APPENDIX [1]

(FROM THE CLINIC OF JOSEPH PRICE, M.D.)

By J. W. KENNEDY, M.D., PHILADELPHIA, PA.

AS I have no prominence as an operator, I feel that it is necessary for me to make some explanation to the profession for my choice of this subject.

The material from which my paper is written is based on over nineteen hundred appendicectomies performed by Dr. Price during my service with him as an assistant, therefore I bespeak for the views of this monarch of abdominal surgery, your kindest consideration.

I would define appendicitis as the most courted, most abused, and treacherous disease which confronts our profession at the present time. The history of the disease is written in such sorrow by the destruction of so many young lives, that we cannot help but rejoice at the progress we have made by the surgery of the day. However, there is much of true surgical interest in its early history, and there are many names which are more than worthy of mention.

The first recorded case of appendicitis was in the year 1759 by Mestiver, who found a rusty pin in the appendix. Doubtless if it had not been that this foreign body was found in the appendix, the profession's attention would not have been called to the organ until 1824, when Mélier called the attention of the surgical world to the fact, that the appendix was an organ susceptible to disease arising primarily in its own structure. Much credit is due this writer, and if it had not been that he was dominated by more conspicuous surgical teachers of his day, we should have known more at an early date of the true pathology of inflammatory condition of the iliac region. It was he who first recognized the causal relation between the chronic affections of the appendix and suppurative tumors of the right groin, and first suggested the possibility of relief by means of operative measures.

The subsequent history of the subject, up to date of the last twenty years, is marked by eras of progression, followed by periods of pathological and surgical standstill. That the progress made in the affection was not a continuous and progressive one, was probably due to the fact that the investigators were studying dead

[1] Read before the Franklin County Medical Society, July 8, 1905, Chambersberg, Pa.

pathology, and, therefore, did not see the disease in different degrees of extension. The parts secondarily involved were as much disorganized as the primary focus of infection.

In regard to the etiology of appendicitis, one is much abashed by the many different opinions of writers and operators. That some few cases are due to foreign bodies, one cannot deny. In the number of patients that form the material from which this paper is written, I saw but one foreign body, which was a cucumber seed, and have reasons to feel that it was more a coincident than cause of the trouble. In this statement, of course, I do not include the concretions which are often found, and may be a product of the inflamed organ, or an important factor in its destruction. An argument in favor of the concretion being a product of the already inflamed organ is, that foreign bodies have been found imbedded in concretions, the foreign body probably being the primary offender, and the concretion a deposit from pathological change in the organ.

Age is a factor; the greater per cent of cases occur between the ages of ten and thirty. However, I have seen all ages with this disease, from a few weeks to a man over eighty years. Trauma seems to be a factor, a good per cent of patients being affected by violent exercise or some hard blow on the abdomen. We do not agree with the number of operators who feel the appendix is poor in its blood supply, and would not give it as a predisposing cause to inflammation. I feel that some importance should be given to turns and twists in the meso-appendix and cæcum, which are often much distorted, and may be an etiological figure as well as a result of the pathology of the organ. Disorders of the digestion, with the consequent bowel disorders, constipation, or diarrhœa have much to do with the drainage of the appendix, which we feel is the most important etiological factor with which we deal.

The anatomical situation of the appendix is such that its cavity is the eddy in the stream. Its inlet and outlet being a common opening make it, figuratively, a dead space in surgery. One can only marvel that we do not have more trouble with this organ. We have a very similar condition of affairs in the gall-bladder, with like pathological lesions. From a simple congestion, due to poor drainage of the organ, I will not attempt to trace the minute pathology of the appendix further, other than to say, that the inflammation is a progressive and destructive one.

The diagnosis of appendicitis in a very great per cent of cases is easily made. The cardinal symptoms are sudden or acute abdominal pain, tenderness on pressure in region of the appendix, and localized muscular rigidity; with such accessory or confirmatory symptoms as nausea or vomiting, increase of pulse rate with slight rise of temperature. Although there are cases in which any combination of these symptoms or signs may not be present, yet I believe the intelligent hand can find an offending appendix. Abdominal pain at some stage in the disease is present and one should not eliminate this organ as its source, without its location can be defined with the greatest integrity. Cessation of pain, with rising pulse and falling temperature, should be looked upon with grave apprehension. If in a patient you find a rising pulse and he makes the statement, that he had pain yesterday, but comfortable to-day, and thus pleads for non-operative measures, he often begs his destruction. Rigidity of muscle on right side is easily appreciated in most cases, and I believe in practically all, to the hand that is daily being educated. A slight œdema of skin over the affected area, even in very early cases, is noticed. History of previous attacks and patient's position in bed with right knee slightly flexed are part of the diagnosis.

In regard to treatment, although I believe at all times in the most intimate co-operation between general practitioner and the surgeon, we cannot admit that medicine, remedial agents, or time should even be looked upon as factors in the treatment. We have not done our duty until every cell of the organ is removed. If the advocate of delay or therapeutic treatment can define certain symptoms or signs, and diagnosticate therefrom the pathological condition of the appendix, we would then be embarrassed by a future return of attack with renewed vigor. No one has attained that refinement in diagnostic skill which enables him to point out from certain symptoms the true condition of the organ,

as the underlying pathology is too often a base deceiver. There is so much in this treacherous disease that appeals to those who see it in its ravages. One who has seen the appendix in the beginning of an attack and followed it by successive cases through all degrees of inflammation to its destruction

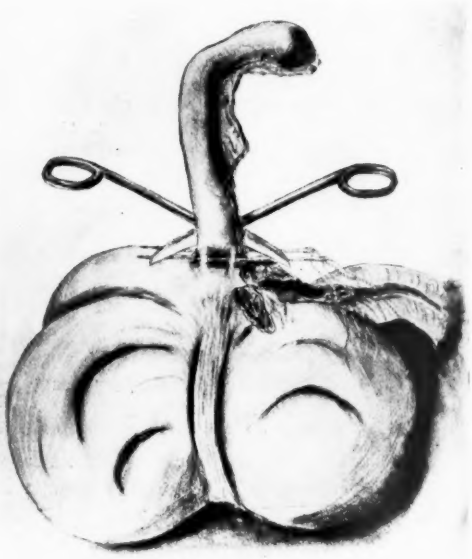


FIGURE 1.—Showing mesentary cut and tied, with needles inserted preparatory to excision.

of viscera and life, and is not mindful of his sacred duty, has not been educated surgically. We have no condition within the limits of our work, which is a more earnest plea for early and completed surgery than lesions of the appendix.

This is not an age of assumed hypothesis or arranged assumptions, but one of hard, cold, pathological, and surgical facts.

Dr. Price has always been an uncompromising and immovable figure in his advocacy for early and complete surgery with this little assassin, as he terms it, and none too dogmatic is he when he says "Every cell must go."

When shall we operate? As soon as the diagnosis is made, and be not too eager to recognize the condition as being moribund, or in other words, you are never too early, and should not refuse operation on account of being too late.

I have divided his procedures for the removal of the organ in three types, classified by extent of the inflammation.

His first hour operation is where the inflammation is confined to the appendix. It may be simply a catarrhal, or even a suppurative, process which has not as yet soiled the peritoneum. His incision is practically at McBurney's point, and is of sufficient length to deliver the appendix.

Dr. Price's two-needle appendicectomy is a stumpless operation. After the meso-appendix has been ligated at the caeco-appendiceal angle and incised so as to leave a good graft, the assistant grasps the cæcum about one inch from the appendix, and with the other hand the distal end of the organ. The operator now inserts two small sewing-needles threaded with number one silk, begins the insertion of the first needle well below the base of the appendix, which is practically the cæcum. Its point of insertion is well toward the center of the appendix. The needle passes just through the muscular coat and out, then around the base of the appendix to a point on the cæcum, opposite its first point of insertion, and is reinserted into muscular coat and out again. The next needle is similarly inserted and parallel to the first needle, the distance between the needles being less than width of the appendix, so that when the sutures are drawn through and tied there is no tendency to eversion of the incised base of the appendix. The apposition is a perfect one. The organ being removed in its entirety, you do not have that hardened and sclerotic tissue to deal with, which is a part of the diseased organ, and has a tendency to evert, and thus prevent nice apposition. Both needles have been inserted without either being infected. Before the appendix is incised if the bowel is pinched together below the needles, they act as stay pins and prevent any soiling of the peritoneum by escape of contents from the bowel. (Fig. 1.) Slight traction being made on the appendix, the

scissors are laid at right angle to the needles, cutting on them as a platform, which protects the bowel, yet every cell of the appendix is removed. The two needles are now drawn through and tied, which practically ends the operation. A slight toilet is now made around the inserted sutures with a wet piece of gauze. As a reinforcement three or four Lembert sutures of fine silk are inserted in the serous layer, beginning near the stump of the meso-appendix and passing over the first inserted sutures; with the last one of these you transfix the stump of the meso-appendix and bring it as a graft over the site of the removed organ. (Fig. 2.)

The operation is an æsthetic one in every step, simple, complete, and quickly done.

Any operation which deals with the stump of the appendix is an unsurgical one. Why leave part of a diseased organ when you can more easily remove it all?

I shall not take up the different operations which treat with the stump, other than to say that the operator who admits he is dealing with a part of an organ which is so foul that it is necessary to crush, burn, or chemically treat it, gives us our strongest surgical argument for its extirpation or complete removal.

I know of no other procedure in which the principles of surgery are so ignored as in the partial removal of the appendix and an attempt to bury this focus of infection in a dead space.

I believe it is a due compliment to the profession to say, that any procedure which deals in any way with the stump of the appendix must soon be a relic to a thinking and progressive profession.

In this class of simple or catarrhal cases you often find the most difficult appendix to remove. It has its type in the appendix which seems to have no meso-appendix, but apparently is imbedded in the head of the colon. Dr. Price likens the condition to a dog's tail grafted or frozen between his hind legs. The operation is a dissection of the organ in its entire length. You deliver the organ by upsetting the colon towards the patient's chin, and make an incision through the adhesions over the appendix, and push off the tissue with a piece of gauze. The appendix is thus extirpated, and the remaining trough is closed by a row of sutures. The abdomen is closed without drainage in this class of cases.

In the second class of cases, known to the profession by the erroneous term of walled off or localized abscess, Dr. Price ignores any dependence upon this inflammatory wall. His incision, though more extensive, is the same as in the first class of cases. He eviscerates all involved bowel, passing each way on intestine until non-inflamed bowel is reached. Breaks all adhesions, flushes off the bowel while it is eviscerated, scrubs intestine with a piece of gauze, removing all flakes of inflammatory lymph, then either makes a local flush of appendiceal region, or with a small gauze sponge on a dressing forcep curettes right iliac fossa. The badly infected or disorganized omentum is removed. This toilet is all made before the appendix is removed. He now

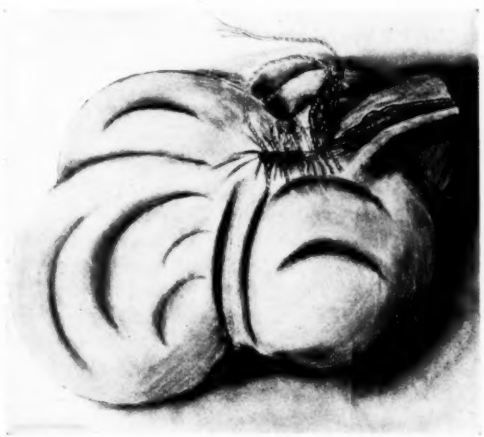


FIGURE 2.—Primary sutures have been tied and Lembert's sutures used to complete the toilet. Last suture being inserted to bring meso-appendix as a graft over the site of the removed organ.

inserts his coffer-dam drain. By introduction of the left hand all viscera are pushed toward median line and held there by the back of the inserted hand. A gauze sponge, size of a man's hand, is then inserted along palmer aspect of the hand which is controlling the viscera. A second sponge is likewise inserted, which forms the external wall of his dam.

These two pads are now separated by insertion of long strips of gauze drain which pass to the most dependent point of the infected area, or to the pelvis if necessary. This drain is a piece of surgical engineering. The indiscriminate insertion of gauze drains is an ignorant attempt at drainage, and often the cause of post-operative obstruction. Not a stitch is placed for closure of the abdomen. During the removal of this drain, at expiration of forty-eight hours, or four or five days, one is profoundly impressed with the thoroughness of drainage. You have a dry well remaining, and not a pond of pus at bottom. The completed toilet primarily, but also the great extent of surface which is drained by coming in contact with the walls of gauze, has done away with the necessity of lumbar or vaginal incisions for drainage through rich lymph spaces. I am sure that operators who feel the necessity for the second incision for drainage, are not completing their toilet primarily by breaking up all adhesions, and thus releasing pus pockets between links of intestine and other abdominal viscera. The operation in itself must be a drainage one by its completed toilet. A great number of post-operative intestinal obstructions, necessitating a second operation, are due to incompleted work primarily. A band of adhesions, or a kinked bowel and partial paralysis of intestine due to inflammatory condition, is sufficient cause for these two frequent obstructions. The tube is an inferior drain, and should not be relied upon where great areas of infected tissue are to be drained. Mixed drainage, rubber, glass and gauze are also a source of danger.

The third class of cases he terms cold-storage cases (ice-bag treatment), with a general peritonitis, distended abdomen, and intestinal obstruction. The picture is one of sad neglect, yet they are still victories for the courageous surgeon. Dr. Price's toilet for these cases is the most complete that is possible to make. His incision is in the median line, so that his toilet can be a universal one. Every inch of the bowel that is possible to eviscerate is delivered through the incision, all adhesions released, both sides of mesentery exposed and cleansed, all viscera flushed and wiped off with gauze while external. The abdominal cavity is then flushed out with several gallons of water. This is truly a flush and not merely filling the abdomen with water. A long irrigator is passed to all points of the abdomen, both loins and renal regions, solar plexus region and pelvic basin and the viscera so manipulated as to allow the water to come from the cavity with a gush. The coffer-dam is then inserted, the intestine being pushed well out of pelvis, the drains enter the same to the most dependent point and are passed to both right and left loins. The removal of the organ and local toilet will not save the patient who is dying from sepsis and obstruction. A relief of obstruction and arrest of sepsis by toilet and drainage is vital in these neglected cases. The appendix and appendiceal region are only a small part of a great area from which the patient is being poisoned from absorption of infected lymph and pus. One should be mindful, that it is a general condition and his toilet a proportionate one. There is no class of cases in which the condition is apparently so hopeless, which promise so much for bold and completed surgery, as these neglected lesions of the appendix.

I realize I have made a plea for radical and heroic treatment in this disease, but such has been my apprenticeship under an operator who has the courage of his convictions and a mortality of less than one per cent.

AN ANATOMICAL, EXPERIMENTAL, AND CLINICAL STUDY OF ACUTE PHLEGMONS OF THE HAND.

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OUTLINE

I. Preface—Questions under consideration and results of the work in general.
II. Methods of study.
III. Serial cross-sections of the hand, with critical study of various spaces and tissues found.
IV. Report of experimental injections from various sites.
A—*Injection of middle palmar space.*
a—*Through the palmar fascia.* (*Expts.* 1–4.)
b—*Via tendon sheath of ring finger.* (*Expts.* 5–9.)
c—*Via tendon sheath of middle finger.* (*Expts.* 10–12.)
d—*Via tendon sheath of little finger* (*Expts.* 13, 14.)
e—*Along lumbrical muscle of ring finger.* (*Expts.* 15, 16.)
B—*Injections of thenar space.*
a—*Via tendon sheath of index finger.*
1. *Moderate force* (*Expts.* 17, 18.)
2. *Great force.* (*Expts.* 22–30.)
b—*Through palmar fascia.* (*Expts.* 19–21.)
C—*Injection of subcutaneous tissue of dorsum in thenar region.* (*Expts.* 31, 32.)
D—*Injection of subcutaneous tissue of dorsum of hand proper.* (*Expts.* 33, 34.)
E—*Injections of subaponeurotic space on dorsum.* (*Expts.* 35–37.)
F—*Injections of hypothenar space.*
V. A study of X-Ray pictures.
VI. A study of the embryology.
VII. Surgical application.
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a—*Predisposing factors.*
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b—*Active, with discussion of important fascial space injections.*
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B—*Lymphatic extension.*
C—*Involvement by extension along connective tissue spaces or synovial sheaths.*
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2. *From the middle finger.*
3. *From the ring finger.*
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5. *From the thumb.*
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PREFACE

THE following study of fascial space infection was undertaken because clinical experience had demonstrated that after the most careful treatment many cases of infection of the hand resulted in unfortunate sequelæ, ending even in ampuputation. The question arose as to the possibility of shortening the course of treatment and producing more fortunate results if we had a clearer idea as to the positions in which pus would lie in the hand, and the proper sites for evacuating it.

As a result of this investigation the following facts may be stated:

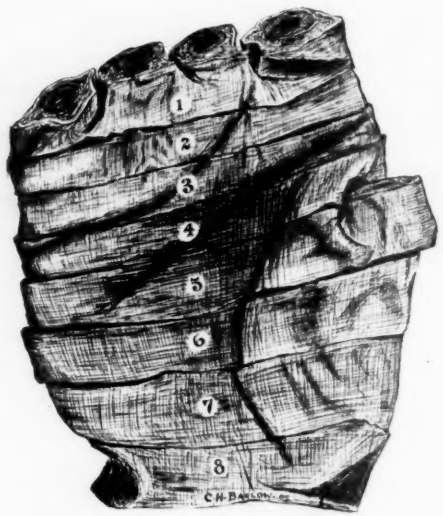
I. There are certain well-defined, uniform spaces upon the fingers, palm, and dorsum of the hand in which pus can accumulate.

II. There are definite anatomical channels by which infection arising in a given spot will extend to certain of these spaces, while certain other spaces will remain uninvolved; hence the diagnosis of the position of the pus is simplified and the proper site for the incision determined.

NOTE.—I wish to make aknowledgment of my obligation to Professor Weller Van Hook, head of the department, for many valuable suggestions; to Professor Gregory, head of the anatomical department, for courtesy in the use of his material and assistance; to my associates, Dr. Cubbins for his excellent X-Ray work, and to Drs. Richter and Besley for much valuable help.

III. There are definite anatomical channels by which pus can spread from the uniform spaces mentioned, and when this occurs, the position of the pus can be prognosticated.

IV. The boundaries of the fascial spaces having been determined, it is readily seen that in some of these the incisions for evacuation must be made at definite spots; otherwise important structures may be injured, or by ill-advised incisions adjacent spaces may be



opened at the same time, and a spread of the infection favored to parts of the hand that would not have become involved without this unfortunate surgical procedure.

V. It can be readily understood why, in certain cases, the infection has persisted for weeks and months after apparently opening the pus pocket, since diverticula and intermediary chambers have not been taken into consideration.

Since making the investigations, clinical experience has shown that the course of many cases may be shortened, and better results obtained, by taking into consideration the facts which have been demonstrated.

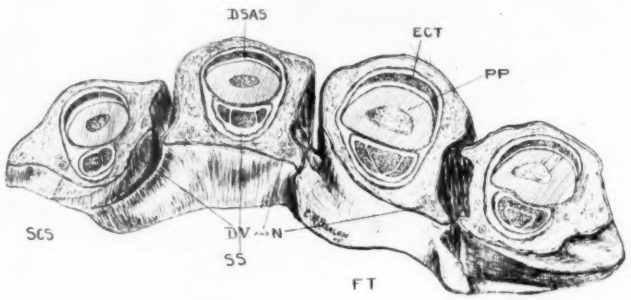
Before beginning a discussion of the subject of fascial space infection, it is well to have in mind its relation to the subject of acute inflammatory processes in the hand as a whole. We exclude from consideration minor infections of the skin, infections of the distal phalanges, primary osteomyelitis and arthritis, confining our attention to the soft tissues of the hand. For the sake of clearness, we have divided the subject into three divisions: *first*, lymphatic infection not accompanied by the accumulation of pus; *second*, infection of the synovial sheaths; *third*, the accumulation of pus in the spaces between the fascial layers. It is to the last of these that we shall give our attention under the title of "fascial space infection." The first and second divisions will be discussed only in so far as they bear a relation to the last, and to this end a few of the experiments we have done upon the synovial sheaths must be detailed, remembering, however, that a complete report upon these is reserved until a subsequent period.

It is true that these various types may overlap, or in one case all three types may be present; but even if that be so, the symptoms and signs are not interchangeable, and there is all the more reason why we should be able to diagnose their presence, since in such a case the three types would still demand different methods of treatment, for in opening a synovial sheath infection we do not by any means drain the fascial spaces, nor vice versa. Again, unless we have a clear picture as to fascial space infection, and, in a given case, do not determine whether or not it is present in an acute teno-synovitis,—and the diagnosis is by no means easy,—we might so make our incision in the synovial sheath that the fascial spaces would become infected unnecessarily; and in a patient who depends upon his hands for his livelihood, such an error becomes criminal carelessness. It is to prevent such errors as this, and to place our indefinite knowledge of this subject upon a scientific basis, that the following study was undertaken.

METHOD OF STUDY

I. With the object of securing a tentative picture of the spaces, a freshly amputated hand was hardened in formaline and cross-

sections made, beginning at the middle joints of the fingers, and cutting sections about one centimeter in width, going to a point slightly above the wrist joint. The fascial layers were then teased out, and their relations to the muscles, bones, tendons, nerves, and blood-vessels determined. The prolongations through the walls. The findings were very uniform and satisfactory, with the exception of three or four which did not reach the spaces intended. The material used was such as that ordinarily found in the dissecting room; hence, while the part was always well preserved, in some cases the material was more friable



Cross Section No. I. See Plate V. for common lettering.
SCS—Subcutaneous space.
PP—Proximal phalanx.
DV and N—Digital vessels and nerves.

of the various spaces were followed up, each space being followed from one section to another; thus its limitations were determined and the relation of the various adjacent structures noted. The specimen chosen was one with but little fat.

The same process was carried out in a fresh cadaver hand in which the vessels were injected and the sections cut while the hand was frozen. Sections were made of a third hand at right angles to the metacarpal bone of the thumb, since it was found that the findings in the thenar area were somewhat confusing. This hand also was frozen, and, like the first and second, without much fat. By these sections, a fairly definite idea of the spaces was secured.

II. To corroborate the findings above, as well as to determine their exact limitations, injections were made into the various fascial spaces, by various channels, and with varying degrees of force. This determined not alone the positions and relations of the pockets, but also by what channels pus could reach them and where it would extend if it broke than in others, and therefore, rupture from the space was more likely to occur. However, this does not interfere with the deductions, since the changes present were, in a measure, comparable to those found in inflammatory processes. Moreover, no matter whether the tissue was fresh or preserved, the findings were the same, so we may feel sure that the results are to be depended upon.

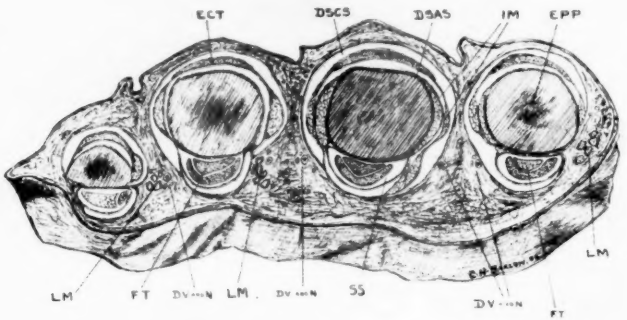
The fascial spaces of forty-eight hands were injected from various sites, by plaster of paris which had been rubbed up with glycerine and diluted with water. It was injected by means of a hand pump, through a canula which was inserted at various points, as will be noted later. As the hands were dissected, the location and paths of extension of the masses were noted. In those cases injected with moderate force, a pressure of four to eight pounds was used, and where forcible injection is noted, twenty-five to thirty-five pounds.

III. Several hands were injected as above except that the injection mass was impregnated with red lead. X-Ray pictures were taken; this showed the relation of the theoretical

pus accumulations to the bones and blood-vessels, the latter having been injected with the same mass. Again, in other hands, injections of various spaces were made, concomitant with injections of the synovial sheaths, to show their relation and the proper site for operations designed to open the former without injury to the latter.

IV. After this work had been done, a study of the embryology was made, with a view to determine whether or not there was any relation between the anatomical peculiarities of the spaces and the method of development. Certain channels will be found that lead directly into them. Certain structures along which pus can pass will be noted as lying in juxtaposition. Again, minor anatomical chambers will be noted; these, however, need little or no consideration from a surgical standpoint, since they are unimportant, not likely to become infected separately, and if they do, they will rupture into one of the larger pockets.

Upon the dorsum two areas will be found, in each of which pus can accumulate to the exclusion of the other. To these are given



Cross Section No. II.—Through epiphysis of proximal phalanx. See Plate V. for common lettering.
EPP—Epiphysis proximal phalanx.
DV and N.—Digital vessels and nerves.

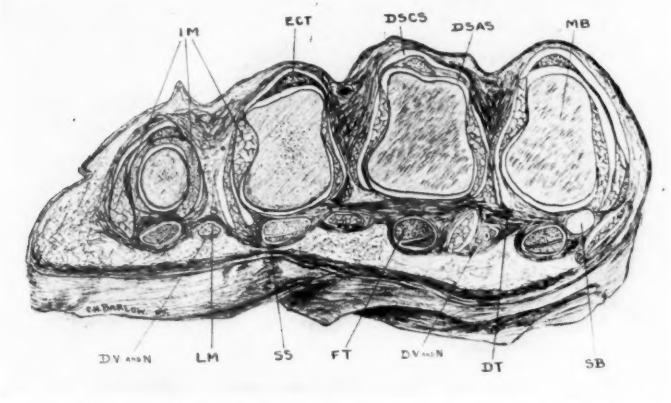
V. The clinical cases that came under observation were observed very carefully to see if the real pathology corresponded with the anatomical demonstration. Bacteriological studies of all cases were made, that we might investigate the relation between the variety of germ present and the tendency to spread.

SERIAL CROSS-SECTIONS

That we may follow the study of the serial cross-sections with more understanding, the following facts should be noted: It is known that five spaces may be found in the hand; the information about them, however, has been very indefinite. Upon the palmar surface we have three distinct chambers, not communicating in any way with each other, and to these are given the names thenar, hypothenar, and middle palmar spaces, respectively. Certain channels will be found that lead directly into them. Certain structures along which pus can pass will be noted as lying in juxtaposition. Again, minor anatomical chambers will be noted; these, however, need little or no consideration from a surgical standpoint, since they are unimportant, not likely to become infected separately, and if they do, they will rupture into one of the larger pockets.

Upon the dorsum two areas will be found, in each of which pus can accumulate to the exclusion of the other. To these are given the names: dorsal subcutaneous space and dorsal subaponeurotic space. We shall find that, while the pus may lie at various levels in the subcutaneous tissue from an anatomical standpoint, yet for surgical purposes, any subdivision of this space is unnecessary and confusing.

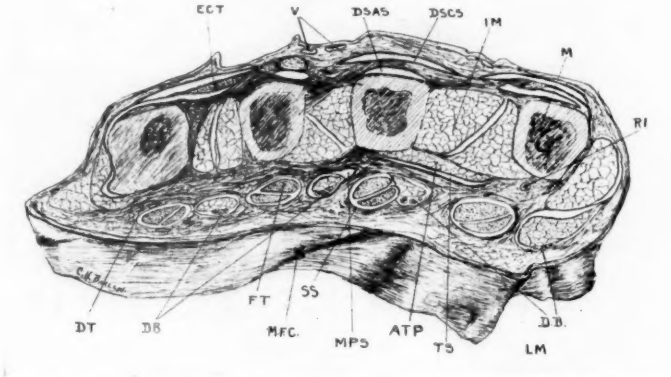
SECTION I.—Beginning with a cross-section that lies just distal to the web of the fingers, we note the following facts: The index finger is slightly different from the middle and ring fingers in that the space which is most superficial, and which we will call "*the subcutaneous space*," does not extend around the entire finger as do the others, but at the radial side the perifascial space tissue is so dense as to obliterate it. It will be noted that this space is deep, and that between it and the skin is to be found considerable tissue which is rather dense and does not lend itself readily to the spread of pus which in this area is more likely to come to the surface or infect the space above mentioned, where it will have little difficulty in spreading proximally or distally.



Cross Section No. III.—Proximal to metacarpo phalangeal joint. See Plate V. for common lettering.
SB—Sesamoid bone.
DT—Dense fibrous tissue.
DV and N—Digital vessels and nerves.

The little finger corresponds with the index finger in that the space is obliterated upon its ulnar side. Between the tendon and the bone in each of the four fingers there is a second space, and to this we will give the name of "*dorsal subaponeurotic space* of the finger," for upon each side of the tendon a dense sheet of tissue is given off, which unites firmly with the periosteum at each side. Upon the flexor surface are found the flexor tendons in their *synovial sheaths*, which sheaths are so closely united to the periosteum that no definite free spaces can be found.

The importance of this intimate relation will be brought out under tendon sheath infection in relation to the frequency of osteomyelitis secondary to this trouble. The spaces above mentioned all pass through this serial



Cross Section No. IV.—Two cm. proximal to joint. See Plate V. for common lettering.
MFC—Middle flexion crease.
DV and N—Digital vessels and nerves.
RL—Radialis indicis.

section into the next, the second cross cut being made through the epiphysis of the proximal phalanx.

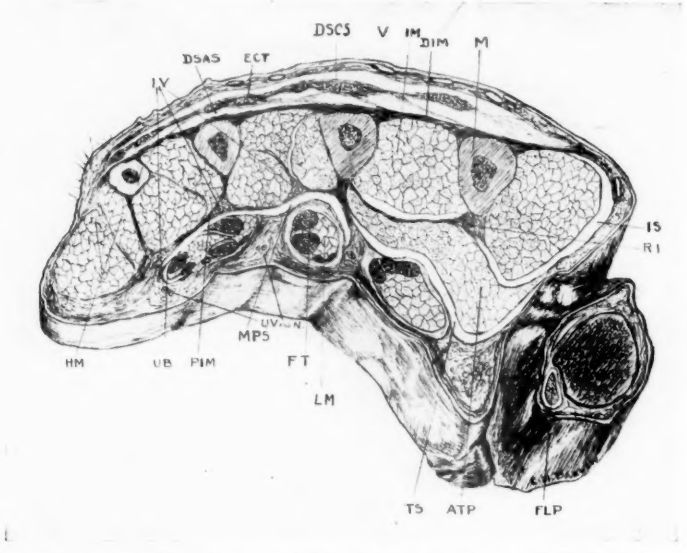
SECTION II.—In this section the salient points may be pointed out briefly so that we can retain a composite picture with that which has just been described.

The subcutaneous space is continuous with that in Section I; at the volar side, however, we note a beginning division into two—a palmar and dorsal.

The subaponeurotic space is also continuous, and the *interossei muscles* begin to appear—one part attached to the periosteum and one part to the dorsal aponeurotic sheet. More important still, we see the beginning of the *lumbrical muscles*, and note particularly the relation of this muscle to the subcutaneous space, especially in the second finger.

Ask yourself where pus would land if it followed down along the muscle from the palm.

As we follow these spaces into the next section, we will see that the subcutaneous spaces upon the abutting sides of the fingers merge into each other; that is to say, the subcutaneous spaces of the ulnar side of the index finger and the radial side of the middle finger join at the web, being in close relation to the lumbrical muscles; slightly proximal to this, as will be seen in the next serial section, the space is obliterated between the fingers, and only a small part remains upon the dorsum of each finger. The dorsal subaponeurotic space is obliterated in this section; i. e., at the joint.



Cross Section No. V.—3½ cm. proximal to joint. Lettering common to all plates.

SS—Synovial Sheath.
DSCS—Dorsal subcutaneous space.
DSAS—Dorsal subaponeurotic space.
ECT—Extensor communis tendon.
FT—Flexor tendon.
LM—Lumbrical muscle.
IM.—Interossei muscles.
M—Metacarpal bone.
BV—Blood vessels.
N—Nerves.
TS—Thenar space.
MPS—Middle palmar space.
ATP—Adductor transversus pollicis.
DIM—Dorsal interosseous membrane.
PIM—Palmar interosseous membrane.
UB—Ulnar bursa.
IS—Space between adductor transversus and first dorsal interosseous.
DIM—Dorsal interosseous membrane.
FLP—Flexor longus pollices in its synovial sheath.
HM—Hypothenar muscles with intermuscular spaces.
IV—Interosseous vessels and nerve.

SECTION III.—The distal surface of the third serial section is seen upon a cut ½ cm. proximal to the joint. Note here—

The absence of the *subaponeurotic space*, except for small diverticula lying between the two parts of the interossei muscle.

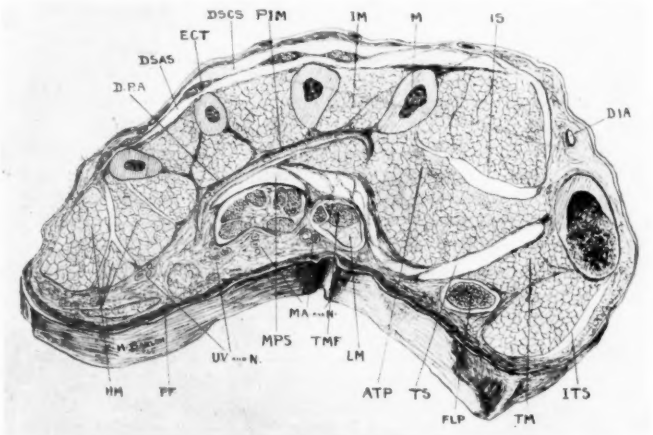
The absence of the *subcutaneous space* between the fingers—presence of small channel upon the dorsum of each finger. This communicates with the subcutaneous space upon the back of the hand.

That the *lumbrical muscle* lies in a sheath of its own, as it were. This communicates with the subcutaneous space of the fingers, and should be followed carefully into the palm.

The *dense layer of tissue* that crosses the whole section lying around and over the tendon sheaths and under the lumbrical muscle.

The spaces are all obliterated in passing through either this section or the previous one, except the synovial space about the flexor tendons, that about the lumbrical muscles, and the slight channel on the dorsum, above noted, passing between the subcutaneous tissue of the finger and the hand.

The surgical nature of this will be brought out later.



Cross Section No. VI.—Through distal part of thenar area. See Plate V. for common lettering.

ITS—Indefinite thenar spaces.
TMF—Tendon of middle finger.
TM—Thenar muscles.
PF—Palmar fascia.
RA—Radial artery.
DPA—Deep Palmer arch—digital branches beginning.
DIA—Dorsalis indicis artery.

Section IV.—The fourth cross-section lies two centimeters above the joint.

The *dorsal subaponeurotic spaces*, which were obliterated at the joint, are beginning again between each tendon and the corresponding bone.

The *dorsal subcutaneous spaces* approximate each other.

The palmar tissue is still dense with no free passages except those about the lumbrical muscles and the synovial sheaths of the tendons which are still present, but begin to be obliterated as they pass through this serial section.

As yet no space has appeared into which pus would extend if it were to pass proximally along these synovial sheaths, except that *a small space has appeared just above the small piece of adductor transversus muscle*, which we note for the first time above the second metacarpal.

Now let us imagine ourselves following through this serial section into the next. The free, open spaces of the hand appear suddenly, the synovial sheaths of the tendons become obliterated after entering them, the lumbrical muscles join the tendons, and the adductor transversus, which is the keynote to the thenar space, begins to assume its characteristic relations.

Section V.—If we cut across about three centimeters above the joint, we find the following, which is well represented in the cut:

There is a large, free space with few fibrous septa extending from the middle metacarpal bone to the radial side of the metacarpal bone of the little finger. It is bounded dorsally by a thin fibrous sheet which overlies the anterior interosseous membrane and the interossei muscles; upon its palmar side is a second thin sheet

separating it from the tendons and the lumbrical muscles of the little and ring fingers. The space is limited upon its ulnar side by dense, fibrous tissue, and upon its radial side by a dense, fibrous sheet which lies over the abductor transversus. This space is probably the most important in the hand, and to it is given the name of "*Middle Palmar Space.*"

Upon the radial side we note the large mass of the adductor transversus, and upon its palmar side is shown a large space extending from the metacarpal bone of the middle finger over the muscle to the radial side of the hand, stopping, however, at the middle of the radial side, at about the level of the palmar surface of the bones; or, in other words, being "L" shaped in cross-section. It will be seen later that this limitation is of importance, since it prevents injection masses from passing freely to the dorsum of the hand, or vice versa. This space is known as the "*Thenar Space.*" Upon its palmar side there is a strong layer of tissue, blending into the dense tissue of the palm, while over the adductor muscle is a thin layer of tissue or perimuscular sheath.

These are the two most important spaces in the hand, and it is well to note their relations to each other and to adjacent structures.

In the first place, they are separated from each other at the middle metacarpal bone by firm septa, so that neither one communicates with the other, nor does either overlap to the other side of this bone. In no experiments made by injections of either space has the mass ruptured into the other space when moderate force was used, so that we know the division is a firm one. The tendons of the third and fourth fingers, with their lumbrical muscles, lie just above the middle palmar space, separated from it by only a thin, indefinite membrane, while upon the palmar side of this group are a few indefinite spaces which will hold a small amount of injection mass if it is made with little force; but if the force of the injection is increased, it must pass around the tendons to their dorsal surface and rupture into the middle palmar space, for in every other direction firm tissue is found; or, in other words, if pus follows down along the lumbrical muscles of these tendons, it must rupture into this space; or again, if it follows along the synovial sheath of the ring finger, and finally ruptures from the proximal blind end, it will pass ultimately into this space. To the ulnar side of the tendon of the little finger is seen the small synovial space representing the continuation of the synovial sheath of the little finger into the synovial sheath of the tendons above, known as the ulnar bursa. In those cases in which the synovial sheath of the little finger is obliterated here (Poirier 25%) that will also rupture into this space. This ending of a synovial sheath infection should not be uncommon, since the section shows the synovial sheaths pass about one-quarter inch out of the dense surrounding tissue noted in the previous section, thus projecting into this space like blind sacs for that distance. This relation will be demonstrated under the discussion of various injections which follow.

It will be seen that the lumbrical muscle and tendon of the index finger occupy the same relative position to the thenar space that the third and fourth do to the middle palmar space with this exception, that in those hands which have been examined, the sheet of tissue separating it from the thenar space is somewhat firmer; still, it is not so dense as that upon the other three sides, and here also, then, it must communicate with the space below it.

The lumbrical muscle and tendons of the middle finger in this section occupy an intermediary place between the two spaces, but in the following section it will be seen to lie over the middle palmar space, at which site the enveloping fascia is much thinner than it is in this location, so that we would have reason to believe, from an anatomical standpoint, that it would communicate more easily with that space and experimental injections of the synovial sheath substantiate this reasoning.

We have now discussed all of the relations of these spaces, except the floor, or dorsal surface, and the proximal prolongation. The latter we will speak of in the succeeding sections. Concerning the floor, however, it is well to mention several things. Owing to the closed nature of these pockets, it is customary for clinicians to draw attention to the frequency of rupture from them, through between the bones, to the dorsal surface.

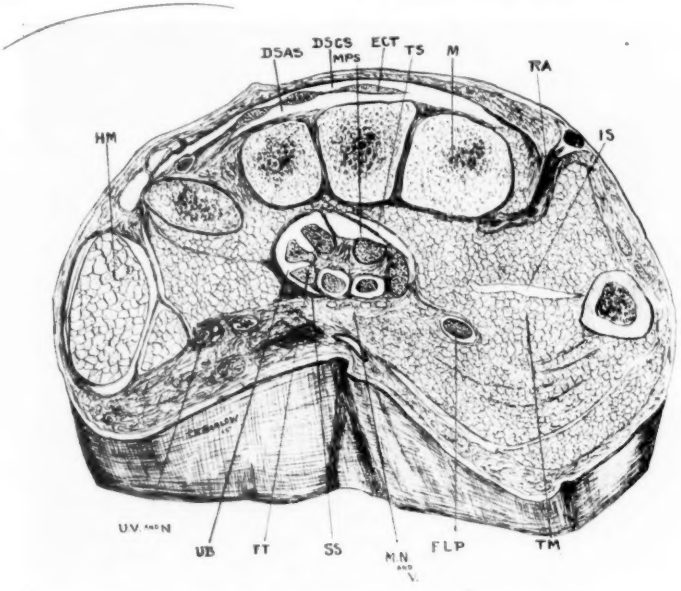
If we were to note the layers of tissue through the middle of the hand, going from the palm to the dorsum, they would be as follows:

1. Epidermis.
2. Derma.
3. Firmly meshed sub-dermal connective tissue.
4. Palmar aponeurosis.
5. Loose mesh of connective tissue, in which lie—

a—Vessels.
b—Tendons with lumbrical muscles, or endings of the synovial sheaths.
6. Anterior middle palmar sheet.
7. *Middle palmar space.*
8. Posterior middle palmar sheet.
9. Vessels.
10. Palmar interosseous membrane, extending from bone to bone.
11. Interossei muscles.
12. Posterior interosseous membrane.
13. *Dorsal subaponeurotic space* filled with thin meshed connective tissue and vessels.
14. Dorsal aponeurosis and tendons.
15. *Dorsal subcutaneous space*, with loose connective tissue.
16. Derma.
17. Epidermis.

sistance, for there is no distinct channel leading to the dorsum, although the intermuscular septa do tend in that direction. Having come through these, however, the pus would then meet a septum, passing from one bone to the other, upon the dorsal surface of the interossei muscles. If the pus meets and overcomes the various obstructions—and clinical evidence shows that it does sometimes—it would then lie beneath the tendons upon the dorsal surface, or in the dorsal subaponeurotic space. This space will be discussed in the subsequent pages.

Now let us go back to the thenar space, and its floor, or dorsal wall. This is slightly more



Cross Section No VII. See plate V. for common lettering.
RV and N—Radial vessels and nerve.
MN and V—Median nerve and vessels.
UV and N—Ulnar vessels and nerve.

In the middle palmar space the floor is is composed of a very thin fascial layer, through which pus could rupture easily, were it not for the support given it by the interossei muscles and the interosseous membrane, upon which it lies. Should inflammatory destruction of this sheet arise, however, or rupture ensue, the interossei muscles would still offer a slight resistance, for there is no distinct channel leading to the dorsum, although the intermuscular septa do tend in that direction. Having come through these, however, the pus would then meet a septum, passing from one bone to the other, upon the dorsal surface of the interossei muscles. If the pus meets and overcomes the various obstructions—and clinical evidence shows that it does sometimes—it would then lie beneath the tendons upon the dorsal surface, or in the dorsal subaponeurotic space. This space will be discussed in the subsequent pages.

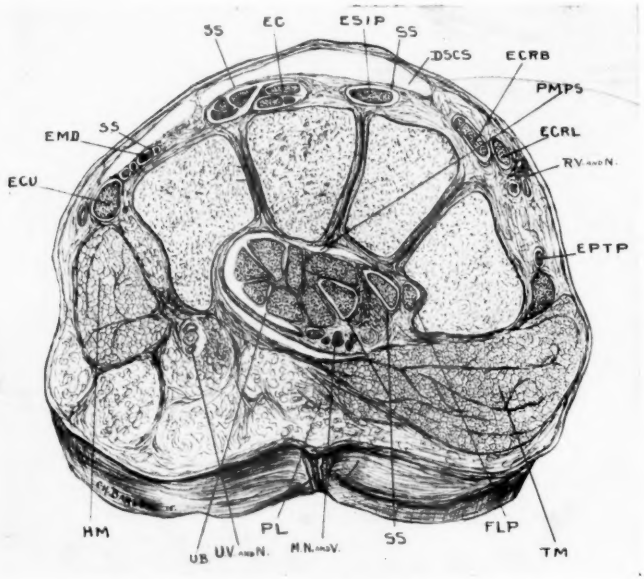
Now let us go back to the thenar space, and its floor, or dorsal wall. This is slightly more complex, in that the muscular masses making up the floor confuse us. For the most part, it is made up of the adductor transversus and the adductor obliquus, and in those cases where there is little tension upon the contents, it would be limited dorsally by them, and the thin sheet of fascia over the muscles. Upon the other hand, if the tension were increased, it would be

very easy for the contents of the cavity to pass between these muscles and come to lie upon the dorsal surface of the adductor transversus. That is to say, it would come against the first dorsal interosseous upon the dorsum of the thenar region about on a level with the matecarpo-phalangeal joint of the thumb, and thus, if there were any inflammatory action present, spread to the cutaneous tissue at the web; or, if the dorsal interosseous muscle were unimportant, in the dorsal subcutaneous tissue of the thenar region. Experimental evidence will be adduced later to prove that this can occur.

This *space under the adductor transversus* is shown in the cross-section. Owing to the freedom of escape in this region, i. e., between the metacarpal bones of the thumb and index finger, there would be little likelihood of any attempt to overcome the greater resistance between the metacarpal bones of the index and middle finger. The small space shown between the adductor transversus and the second interossei is therefore of no surgical importance.

Thus the thenar and middle palmar fascial spaces are seen to be the only important spaces here. They will be taken up later, and a composite picture made from the fragmentary description noted here and in the following serial sections.

Concerning the dorsum of the hand, we note, also, certain vital anatomical peculiarities. The separate *subcutaneous spaces* noted in the last section are seen to have blended so that pus can extend freely over the entire dorsum. But what concerning the pus which we noted as breaking between the interossei to the dorsum? That would lie under the tendons in what may be called the *dorsal subaponeurotic space*, since the tendons are joined to each other by a very firm aponeurosis, and in many cases a tendon will spread out fan-like to supply two or three fingers, so that we have a very dense sheet of tissue extending from the metacarpal bone of the little



Cross Section No. VIII. See Plate V. for common lettering.
RV and N—Radial vessels and nerves.
MN and V—Median nerve and vessels.
UV and N—Ulnar vessels and nerves.
PMPS—Prolongation middle palmar space

finger over to the ulnar side of the metacarpal bone of the index finger, through which it is often almost impossible for pus to escape. The evident important surgical relation of this fact will be discussed later.

SECTION VI.—This serial section is taken through the distal part of the thenar eminence, and thus shows the metacarpal bone of the thumb in cross-section. Here we note the great relative size of the *thenar space*, and yet it is all upon the radial side of the middle metacarpal. The lumbrical muscle and index tendon are separated from it by a much thinner septum than in the previons section. The tendon of the flexor longus pollicis appears here surrounded by its synovial sheath.

In the cases examined it is separated from the thenar space by a considerable amount of tissue, and while rupture from it into the space is possible (particularly in those cases accompanied by inflammatory destruction), yet it would be more likely to rupture at the upper end of the synovial sac into the cellular tissue of the forearm. Experimental evidence to support this will be brought forward in a subsequent paper.

The *middle palmar space* is much smaller, and still lies under the group of tendons of the middle, ring, and little fingers. Upon the ulnar side of this group we see the ulnar synovial bursa in juxtaposition to the space, yet the septum between them must be strong, since the injection masses in this bursa, noted later, have a greater tendency to rupture into the forearm than into this space.

Upon the dorsum we still find our *subaponeurotic and subcutaneous spaces*, while over the thenar area the subcutaneous tissue is also lax, and either of the two former spaces can be made to communicate with it.

SECTION VII.—In the seventh section, taken through the base of the palm, the *middle palmar space and the thenar space* are seen to have shrunk into insignificance. They lie close together under the group of tendons, the middle palmar space being more superficial. They are still separated by a thin sheet, however, in those specimens examined.

One or two *indefinite spaces* are present about the thenar region. They are of little importance, however, except to note that they are present between the groups of muscles, and localized infection can occur in them under exceptional circumstances.

The *dorsal spaces* remain the same, except that the subaponeurotic is more constricted.

Nothing as yet has been said of the *hypothenar area*, since it was desirable to avoid confusion. However, a glance at this section, and at those which have preceded, shows very clearly that while it is possible for pus to accumulate in the intermuscular septa of this space, yet it would be absolutely localized here, and would spread to the surface. It would not enter either the middle palmar space or the ulnar synovial bursa. Such infections would be of little surgical interest, owing to their localized nature.

SECTION VIII.—In the eighth section, taken at the wrist, the *middle palmar and thenar spaces* can still be found, but they are so small as to be of little practical importance, since any inflammation in them would probably be followed by closure. Their behavior under forcible injection will be noted later.

While it might be possible by forcible dissection to produce a dorsal subaponeurotic space, yet it should not be described as being present.

The dorsal subcutaneous space can be demonstrated, but it is more difficult to do so here than in the previous sections, since more of the fibers tend to intermingle from layer to layer.

TO RECAPITULATE

We note that we have five great spaces, with their tributaries, in which pus can accumulate.

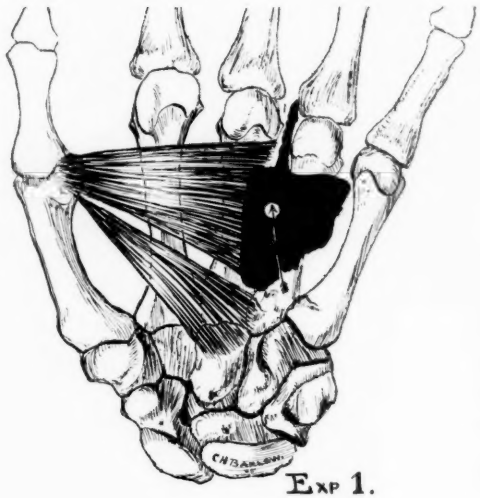
First, the dorsal subcutaneous, which is an extensive area of loose tissue, without definite boundaries, allowing pus to spread over the entire dorsum of the hand.

Second, the dorsal subaponeurotic, limited upon its subcutaneous side by the dense tendinous aponeurosis of the extensor tendons, upon the deep side by the metacarpal bones, having the shape of a truncated cone, with the smaller end at the wrist and the broader at the knuckle. Laterally the aponeurotic sheet shades off into the subcutaneous tissue.

Third, the hypothenar area, a distinctly localized space.

Fourth, the thenar space, occupying, approximately, the area of the thenar eminence, to the flexion adduction crease of the thumb, not going to the ulnar side of the middle metacarpal. It should be remembered that this space lies deep in the palm, just above the adductor transversus.

Fifth, the middle palmar space, with its three diverticula below along the lumbrical muscles, limited by the midde metacarpal bone upon the radial side, overlapped by the ulnar bursa upon the ulnar side, and separated from the thenar space by a partition which is very firm every-



Exp 1.

where except at the proximal end, where it is rather thin. A small isthmus can be found leading from the proximal end of the space under the tendons and ulnar bursa at the wrist up into the forearm.

Report of Experimental Injections of Various Fascial Spaces

In the following the spaces were injected and the injected mass dissected out.

A. Injections of the middle palmar space.

a. Through palmar fascia.

Experiment 1.—Left hand. Canula inserted through the palmar fascia where middle flexion crease crosses metacarpal space between ring and middle fingers. Moderate force used. Note—Care must be taken that the canula goes dorsal to the tendons, i. e., really into space, otherwise the mass will be confined to the imperfect spaces around the tendons, particularly superficial to them. Even if this should occur, if great force is used, it will rupture into the great space; not so readily, however, as would pus, since the erosive action of the latter is not present in simple injections.

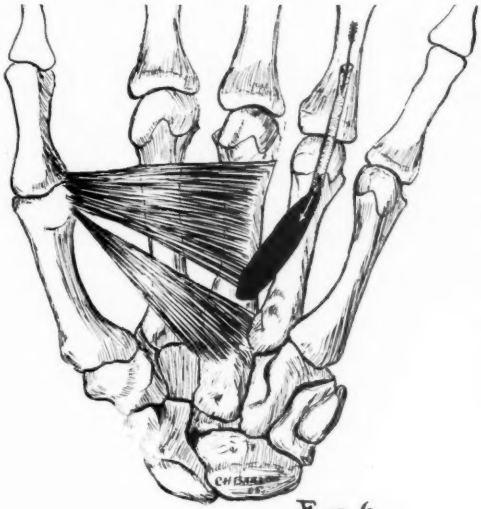
Upon dissection the mass was found to be limited to what we have found is the middle palmar space. It was limited upon the radial side by the attachment of fascia to the middle metacarpal bone. This was the long leg of the right-angled triangle. The ulnar side represented the hypothenuse of the triangle lying to the radial side of the hypothenar space. The apex of the triangle, or the highest point to which the mass spread, was about one inch distal to the distal flexion crease of the wrist or about a finger's breadth proximal to a line drawn transversely across the palm from the web of the extended thumb.

At the lower part of the palm, i. e., toward the web of the fingers, the greater part of the mass was limited by a line drawn between the radial end of the middle flexion crease and the ulnar end of the distal flexion crease of the palm, or, roughly speaking, about a thumb's breadth above the web of the fingers; this is the short leg of our right-angled triangle. A prolongation of the mass had taken place, however, along the lumbrical muscle between the middle and ring fingers going almost to the web of the finger. There was no appreciable mass along the other lumbrical muscles, although some of the stain from the methylin blue used in the injection mass had stained the space around the muscle leading to the little finger. No other prolongations were present. It did not break into the interossei muscles or superficially about the tendons. Superficial palmar vessels crossed upper part of mass. (See experimental injection drawing.)

Experiment 2.—Left hand. Injection same point and manner as No. 1. The mass here occupied exactly the same area of distribution as No. 1, except the mass as a whole was not so large, being a little larger than an almond. The most prominent part of the mass was in the middle of the palm, over the middle metacarpal space. Slight prolongations distally along lumbrical muscle between ring and middle metacarpals as above.

Experiment 3.—Injection made same as No. 1. Both X-Ray picture and dissection made of this right hand. Mass extended somewhat higher in the hand than in No. 1, going to a point about a finger's breadth below, i. e., distal to the distal flexion crease of the wrist lying dorsal to the tendon group; laterally its boundaries were the same, while at the distal portion of the palm a prolongation of the mass occurred along the lumbrical muscles going to the little,

Exp. 5.



Exp. 6.

ring, and middle fingers. This is of considerable importance, since it is remembered that the relation of the lumbrical muscle of the middle finger to the middle palmar space was discussed in the division devoted to cross-sections and this experiment bears out the assumption hazarded there that this muscle space was really a diverticulum of the middle palmar space and not of the thenar space. (See cross-sections No. V and VI.) (See X-Ray Plate No. I.)

Experiment 4.—Injection left hand, same as No. 1. Mass occupies same space as No. 1, except mass spread down along lumbrical muscles of little and ring fingers for a distance of one-third inch.

b. Injection of the middle palmar space by way of the tendon sheath of the ring finger. The tendon sheath being opened at the base of the finger and the canula inserted in the sheath and pushed through the proximal blind end into whatever space was at that site, thus trying to demonstrate where an infection would spread to if it extended from the tendon sheath. In one case, which is not included in the report, the tendon sheath did not end blindly, but extended up into the group of tendons at the wrist.

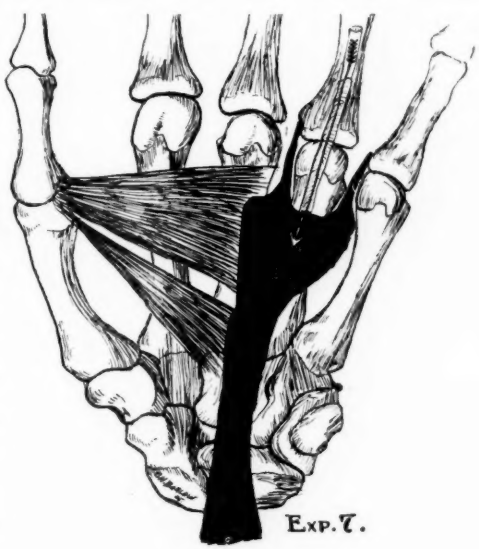
Experiment 5.—Right hand. Moderate force used. In this case the mass occupied the middle palmar space as it has been described. No diverticula were noted except that the mass extended along the lumbrical muscles of the ring finger for about one-half inch. (See experimental injection drawing.)

Experiment 6.—Right hand, moderate force used. In this case the canula broke from the blind end evidently superficial to the tendon, for there was a small mass only, lying superficial to the tendon, about a quarter of an inch wide and three-quarters of an inch long. It had not involved the middle palmar space, but it was seen that the thinnest wall was in relation to that space, and in case of infection would have extended to it in all probability. (See experimental injection drawing.)

Experiment 7.—Left hand, along tendon sheath of ring finger; the mass was injected with considerable force. The middle palmar space as described was filled. Thenar and hypothenar area free, mass along little and ring finger lumbricals for three-fourths inch, none along other fingers, none through between bones to back, mass extended under tendons strictly, up into forearm, where a large mass was found lying under the deep muscles upon the pronator quadratus and the inter-muscular septum up to the pronator radii teres, came to the surface late upon the radial side at about two inches above wrist, but the mass was most marked upon the ulnar side from above downwards between the flexor carpi ulnaris and the deep tendons and muscles. The importance of the position of this mass from a clinical standpoint can be seen.

Experiment 8.—Same findings as Experiment 7.

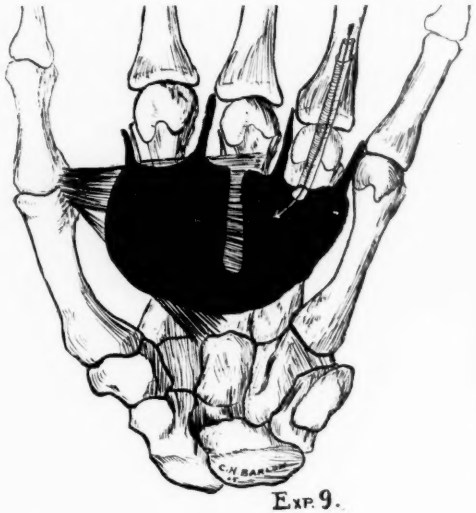
Experiment 9.—Wrist bound tightly above annular ligament; canula inserted along ring finger synovial sheath and mass injected with great force, the idea being to see where the mass would rupture in case that means of exit were closed. None of the mass went to the forearm or dorsum, but did rupture into the thenar space at the upper or proximal end of the intervening septum and filled the thenar space, passed along all lumbrical muscles into canals for a considerable distance but not out into the web between fingers. (See experimental injection drawing.)



Exp. 7.

c. Injections via tendon sheath of middle finger. A consideration of this subject is of considerable importance, owing to the question of its relation to the thenar and middle palmar spaces already mentioned. In inserting the canula no effort was made to reach any particular spot, but it was allowed to rupture through any spot which was the weakest in its course.

EXPERIMENT 10.—Left hand. Canula inserted into tendon sheath of middle finger at the middle of the proximal phalanx, moderate force used in injection. The mass occupied the middle palmar space only, going up to about one-half inch below annular ligament. Downward it had returned along the lumbrical muscles of the little and ring fingers nearly to the web of the fingers. It did not return to any extent along the lumbrical muscles of the middle finger. In every way this was a beautiful representation of what is probably a typical collection in the middle palmar space. (See experimental injection drawing.)



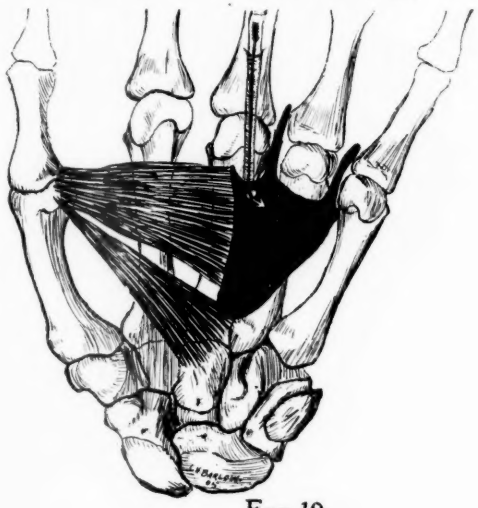
EXP. 9.

EXPERIMENT 11.—Left hand. Same as No. 10 in every particular. No mass to radial side of middle finger.

EXPERIMENT 12.—Right hand. Same as No. 10 in every particular.

d. Injections of the middle palmar space from tendon sheath of little finger.

EXPERIMENT 13.—During an attempt to inject the ulnar sheath in the right hand it was found to be obliterated at the phalango-metacarpal articulation. The canula broke out into a space which was injected with moderate force and upon dissection the middle palmar space as already described, was found filled with the mass. It had not gone up into the wrist, over into the thenar or hypothenar areas, but had returned along the lumbrical muscles of the little, ring, and middle fingers. (See experimental injection drawing.)



EXP. 10.

EXPERIMENT 14.—In another attempt to inject the ulnar bursa with moderate force, the injection mass was arrested at the annular ligament owing to the rigidity of the tissues of the subject. Due to this fact and the friability of the tissues incident to age, the ulnar bursa ruptured at about the middle of the palm and the mass was found to occupy the middle palmar space only, in addition to the ulnar bursal sheath of the tendons. The mass returned along ring finger lumbrical only. The surgical importance of this experiment is readily seen. (See experimental injection drawing.)

e. Injection of middle palmar space along lumbrical muscle of ring finger.

EXPERIMENT 15.—Canula inserted along lumbrical muscle, left hand. Some difficulty was experienced in the insertion, but when successful the mass occupied the middle palmar space. No return along lumbrical muscles. Moderate force used in injection. (See experimental injection drawing.)

EXPERIMENT 16.—Right hand, Same technic, injection mass lies along lumbrical muscle. Middle palmar space only partly filled.

B. INJECTIONS OF THENAR SPACE.

Note.—The first injections of this space were very unsatisfactory owing to two errors in technic which were corrected later. In the first

place, the injections were not made deep enough; and secondly, they were too far to the radial side over the thumb. It is true that the results obtained by these injections were instructive in that they served to show indefinite limited

spaces at these sites, but they did not reach the large space under consideration.

a. Injections via tendon sheath of index finger.

EXPERIMENT 17.—Right hand, canula inserted into tendon sheath about middle of proximal phalanx and ruptured from sheath at its proximal end. Moderate force used in injection. The mass when dissected out showed the limitations of the space as described. The mass passed up dorsal to the tendon, to a thumb's breadth below the annular ligament. It did not go to the ulnar side of the middle metacarpal. The mass laid directly upon the adductor transversus. It did not go along the lumbrical muscle to the side of the index finger. It did not spread around under the web of the thumb to the dorsum of the hand, but was limited at the distal border of the adductor transversus. (See plate.) It did spread to the back, however, at the upper or proximal edge of the adductor transversus, going between the adductor transversus and the adductor obliquus, thus lying between the adductor transversus and the first dorsal interosseous, at the distal edge of which it came to lie in the subcutaneous tissue of the dorsum. (See experimental injection drawing.)

EXPERIMENT 18.—Injection same as No. 17. Here the mass did not fill the space completely, but did return along the lumbrical muscle to the radial side of the index finger, condition well marked. For clinical purposes Experiments 17 and 18 should be studied together. The probability is that the canula did not rupture entirely into the space, but did get out of the synovial sheath into the indefinite spaces in the loose connective tissue about the tendon in the loft, as it were, of the thenar space. (See experimental injection drawing.)

b. Injection through palmar fascia in attempt to reach the thenar space. To do this properly, the canula should be inserted about the middle line of the palm one centimeter to the thenar side of the adduction flexion crease of the thumb.

EXPERIMENT 19. — Left hand. Canula inserted into middle thenar space, moderate force used in injection. Mass was found to have filled the space completely, but had not followed along the index lumbrical muscle to the finger nor had it gone to the dorsum under the subcutaneous tissue. The space filled corresponded to the area comprised between the adduction crease of the thumb and the metacarpal bone of the thumb in adduction. (See experimental injection drawing.)

EXPERIMENT 20.—Attempt to inject thenar space. Right hand. Canula was inserted too far to radial side over muscular group. Small mass was found in indefinite space adjacent to flexor brevis pollicis. (See experimental injection drawing.)

EXPERIMENT 21.—Same as No. 20.

c. Injection of thenar space under forcible pressure. Owing to the fact that the routes of extension from the thenar space were somewhat difficult to determine accurately, nine injections of this space were made, with the following results: In none of the cases did the mass

go up into the forearm. In three cases only did it go into the middle palmar space. In eight cases the mass passed dorsal to the adductor transversus; of these, in six the mass went to the dorsum between the adductor transversus and the adductor obliquus, and in four passed below or distal to the adductor transversus to lie between the transversus and first dorsal interos-

Exp. 15.

seous. In no case did the mass pass to the dorsum between the second and third metacarpals. The index synovial sheath was opened and canula forced out of the proximal end into the palm, forcible pressure with force pump was maintained for from three to five minutes.

Experiment 22.—Mass occupied thenar space, did not go into forearm or middle palmar space. Passed around lower or distal edge of adductor transversus and then filled space size of walnut, between that muscle and the first dorsal interosseous, abutted on dorsal subcutaneous tissue at web. Followed index lumbrical only. (See experimental injection drawing.)

Experiment 23.—Same findings as in experiment 22.

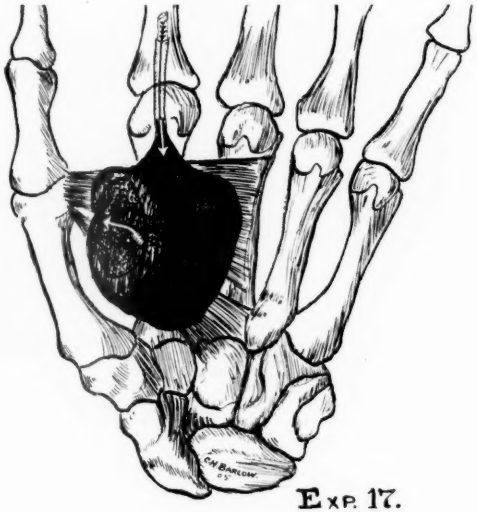
Experiment 24.—Left hand, tissues well preserved, mass here occupied thenar space, and spread between adductor transversus and adductor obliquus to fill space size of walnut between them and first dorsal interosseous; also ruptured through tissues between thenar space and middle palmar space at the proximal end of the septum, passed over to fill the middle palmar space, and accompanied the four lumbricals into their respective canals. Did not go under tendons to forearm.

Experiments 25, 26, and 27 were the same as No. 24 except that No. 27 did not invade the middle palmar space. All went above the adductor transversus to dorsum, however. No. 26 passed along middle finger lumbrical and came to lie in the tissue of the web immediately beneath the web. (See experimental injection drawing).

Experiment 28.—This mass extension was extremely interesting. It filled the thenar space and then passed to the space between the adductor transversus and first dorsal interosseous, going both above and below the adductor, i. e., both proximal and distal, abutting on dorsal subcutaneous tissue at web at distal edge of first dorsal interosseous, extended along index lumbrical canal and did not go into middle palmar space or forearm. The most interesting extension, however, was that which occurred through the palmar aponeurosis at the distal edge of the bases of the index and middle fingers into the soft pad of fatty tissue which lies here in the palm, thus giving corroboration to those clinical cases which are on record in which pus has pointed here, supposedly through an imperfect palmar fascia. This was the only experimental injection in which a mass appeared in the palm. (See experimental injection drawing.)

Experiment 29.—Result same as 28, except no subdermal palmar extension.

Experiment 30.—Mass filled thenar space; no extensions except along index lumbrical canal.



Exp. 17.

C. Injection of subcutaneous tissue of the dorsum between the first and second metacarpals.

Note.—These injections were made to determine the relation of these spaces to the thenar

space and the remainder of the subcutaneous tissue on the dorsum.

EXPERIMENT 31.—Injection right hand, moderate force, inserted into subcutaneous tissue on dorsum thenar region. Mass was found to be subcutaneous, and while there was evidently a tendency to limitation at the index metacarpal, yet it is doubtful if it was due to the attachment of fascia to the bone, being more

EXP. 18.

likely to be the natural tendency to limitation found in the meshes of any loose tissue. Moreover, in spite of the partial limitation at this point, it had spread into the subcutaneous tissue above the tendons going from the wrist proximally to the metacarpo-phalangeal articulation distally and over to the level of the fourth metacarpal bone. It did not go through to the palm by any channel.

EXPERIMENT 32.—Injection of left hand same as above. Mass upon dissection found to occupy dorsal thenar subcutaneous tissue over to the index metacarpal, beyond which it did not extend. It did not pass to the palmar surface nor into the thenar space.

D. INJECTION OF THE SUBCUTANEOUS TISSUE OF THE DORSUM BETWEEN SECOND AND THIRD METACARPAL BONES.

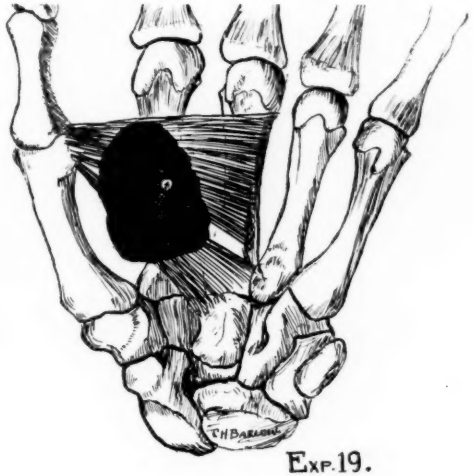
EXPERIMENT 33. — Right hand, canula inserted into subcutaneous tissue of dorsum of hand and the mass was injected with considerable force. The tip of the needle was superficial to the tendons but deeper than the superficial layers immediately beneath the skin. Upon dissection, mass was found to occupy considerable space extending from the wrist above to the metacarpo-phalangeal articulation below, and from the metacarpal bone of the index finger to the metacarpal bone of the little finger, proximally and distally, at the wrist and fingers respectively, the tissue seemed to be bound more firmly to the underlying tissue than laterally.

EXPERIMENT 34.—Left hand, technic and results same as No. 32. A study of these two show several layers of fascia between the skin and tendons with no single space more distinct than another.

E. INJECTIONS UNDER TENDONS OF DORSUM.

The importance of this series is seen when we remember that it is in this space that pus would lie if it ruptured through between the metacarpals from the palmar surface. The results obtained were uniform.

EXPERIMENT 35.—Left hand, canula tip inserted under tendons between middle and ring finger at lower third of dorsum. Considerable force was used in the injection. The mass was confined to the space under the tendons, i. e., was covered by the tendons and the aponeurosis between them. It passed up to the wrist, down to within one-half inch of the finger, and laterally to index metacarpal and little finger metacarpal, thus having the shape of a truncated cone flattened on one side. The mass appeared to be ready to break out upon the ulnar side, but none had done so. (See experimental injection drawing.)



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EXPERIMENT 36.—Left hand, techinc and results same as No. 34.

EXPERIMENT 37. — Right hand, canula inserted between tendons of ring and little fingers, at the middle of the dorsum of the hand; entire subaponeurotic space filled; no tendency to rupture between tendons, but did show evidence of beginning extension at two sides over index metacarpal and little finger.

F. INJECTIONS INTO HYPOTHENAR SPACE SPREAD FROM THE SITE OF INJECTION ONLY AFTER CONSIDERABLE MANIPULATION, AND THEN THE MASS WAS LIMITED TO THE HYPOTHENAR AREA, NEAR THE POINT OF INSERTION.

The details of the other injections are omitted, since they only corroborate the findings already noted.

That we may have a clear understanding of the results obtained by experimental injection, let us summarize them. The mass in the middle palmar space, in practically every case, filled the space we have outlined. In no case did it go beyond the middle metacarpal bone, nor into the hypothenar area, except the case noted where a band was tied about wrist and the mass then ruptured into the thenar space. In every case there was some extension along the lumbrical muscles, almost always going down between the bases of the middle and ring fingers, and sometimes between the little and ring fingers, and more uncommonly, the middle and index fingers. Unless great force was used, this was the limit of the extension. When it was used, the mass then passed upwards under the tendons into the forearm, where it spread beneath the deep muscles nearly up to the elbow before it came to the surface at the lower part of the forearm. The mass had for its deep wall the pronator quadratus and the interosseous septum. In no case did the mass go through between the bones to the back, but it was seen how easy it would be for that to occur if the outlet at the upper end were closed, as by inflammatory swelling and adhesions.

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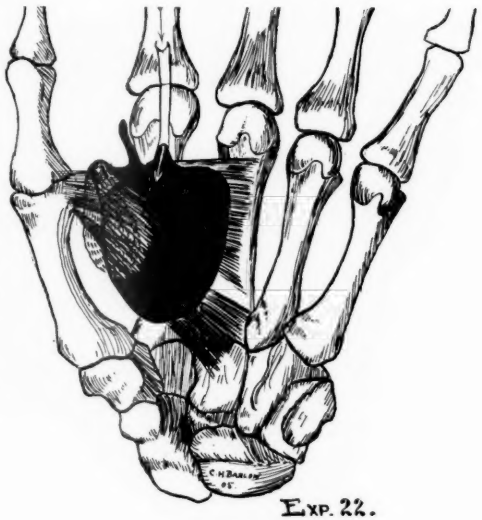


EXP. 22.

The thenar space was found to be a large space, but lying very deep. It was not continuous with the subcutaneous tissue of the dorsum, and the mass was limited at the free palmar edge of the radial side of the palm. The mass did, however, (when force was used) go above, and less frequently below, the adductor transversus, into the perimuscular sheath on the dorsum, lying between this muscle and the first dorsal interosseous. It also spread down along the lumbrical muscle of the index finger, making a diverticulum from a fourth to a half inch long. In no case did it spread up into the forearm, even though anatomical dissection demonstrated that this would be possible, although improbable, and if it did it would be in the same site as that described for masses coming from the middle palmar space. In no case did the mass lie to the ulnar side of the middle metacarpal bone, unless great force was used in the injection; then it passed through the upper part of the septum and filled the space in one third of the cases. Injections into the hypothenar area showed the spaces to be localized and perimuscular for the most part not communicating with any large

space, and hence of no particular surgical importance.

Injections of the subaponeurotic space demonstrated that the mass would not rupture through the aponeurosis unless anatomical exceptions were present. It would spread up to the wrist, down to the fingers, and laterally to the edge of the index or little finger tendon, and if greater force were used, would tend to spread under the subcutaneous tissues at the side, particularly the ulnar.

Injections of the dorsal subcutaneous tissue showed no particular pockets, but did show a tendency to localization at any site injected because of the obliquity of fibrous bands crossing from space to space. If the injection was given with great force, the mass spread equally in every direction, except there seemed to be some particular factor at work, limiting, in a certain measure, the spread of the mass over the index metacarpal from the dorsum of the hand to the thenar dorsal region, and *vice versa*.

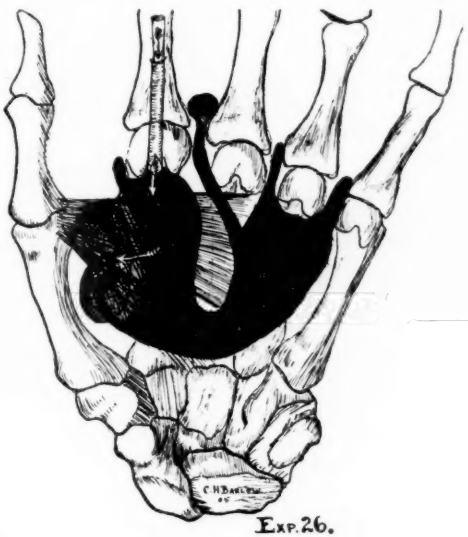
The injections through the synovial sheaths of the tendons of the ring and middle fingers, passed into the middle palmar space, while that space was reached also from the little finger in those cases where the synovial sheath was distinct from the ulnar bursa — and indeed the ulnar bursa itself, when it ruptured to the palm, entered the same space. Injection of the index synovial sheath passed into the thenar space. In those cases where the synovial sheath of either of these fingers communicated with the ulnar bursa, the mass passed into that, and followed the course of any ulnar bursal injection. The extreme rarity of communication between the index synovial sheath and the ulnar bursa, robs that point of any surgical interest such an anomaly would have. Deep injections of the palm went into the spaces lying underneath, and since these spaces do not overlap, except at the wrist, only one space is affected by a given punctured wound. It must be remembered, however, that the lymphatic channels, from the center of the palm, pass deeply into the tissue and come to lie immediately adjacent to the adductor transversus, so that a lymphatic abscess from a punctured wound might lie in the thenar area, although the puncture might appear to be at the radial side of the middle palmar space.

The radial bursa, or the synovial sheath of the flexor longus pollicis, if it ruptured in the hand, would lie in the indefinite spaces mentioned as lying directly over the muscles of the metacarpal bones of the thumb. It is possible for it to erode into the thenar space, but it is more likely to rupture into the fascial spaces of the forearm.

A study of the X-Ray pictures

Four of these have been chosen for illustration.

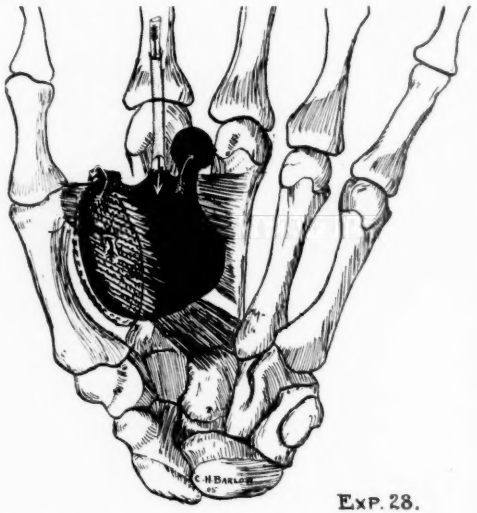
X-Ray 1. This hand was also dissected (See Case 3). It represents how the mass extends



down along the lumbrical muscles, and shows also what site should be opened to evacuate the contents of the space. Note that the hypothenar and thenar regions are uninvolved, the mass not extending to the radial side of the middle metacarpal. It is seen that the ulnar bursa would lie over the ulnar side of the mass.

X-Ray 2. In this picture the ulnar bursa was injected and is seen in faint outline. The thenar space was filled also by a puncture through the palmar fascia. The value of this picture lies in the fact that it shows the relation of these two compartments, and in particular, that it outlines the parts of the middle palmar space that is not involved by either. Hence, it

shows us where the incision can be made without producing an extension to the two parts mentioned. Note the intimate relation of the upper part of the thenar mass, and that lying in the ulnar bursa, the latter being superficial to the former. Note, again, that the lower part of the space between the ring and middle finger



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is separated entirely from either of the injected areas.

X-Ray 3. In the third picture we have a clear picture of the bones in their relation to the injected blood-vessels and ulnar bursa. Upon this plate have been placed lines which represent the boundaries of the thenar and middle palmar spaces. The numerous parallel lines at the distal end of the palm represents the dense tissue here overlying the articulation in which there are no spaces except those made by the lumbrical muscles, vessels, and the synovial sheaths. (See cross-section No. iii.) Three curved lines show the position of the flexion creases of the palm of the hand, and in relation to these, note that the proximal end of the distal flexion crease correponds with the beginning of the dense tissue noted. Again, note that the distal end of the middle flexion crease also begins at the dense tissue, and hence a line drawn between these two points limits the palmar spaces distally. Pay particular attention to the point at which this middle flexion crease crosses the space between the metacarpal bones of the middle and ring fingers, at the distal end of the middle palmar space, avoiding the thenar space upon the radial side, the ulnar bursa upon the ulnar side, the dense tissue distally, and the deep palmar arch which is seen crossing the upper part of the middle palmar space proximally. Note that although the injection mass has broken from the ulnar sheath in the forearm, yet the spaces in the hand are uninvolved. All of these facts are of the greatest surgical importance.

X-Ray 4. In this plate both the thenar and middle palmar spaces were injected with force from the index and ring fingers respectively. The thenar mass remained in its usual compartment, while the middle palmar mass passed up under the group of flexor tendons into the forearm. Note the prolongations along the lum-

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brical muscles, and the thinness of the mass under the site of the annular ligament.

A STUDY OF THE COMPARATIVE EMBRYOLOGY throws some light upon the natural divisions of the hand, but unfortunately this has as yet only been worked out in relation to the palmar fascia and the tendon groups. Dr. McMurrich (*Am. Jr. of Anatomy*, Vol. No. 2, Page 202) described the relation of these in amblystoma. The muscular masses which here arise in the palmar fascia, and which correspond to the superficial tendons in the mammalia, divides longitudin-

ally into three groups, the lateral parts destined for the second and fifth digits, separating from the median parts destined for the third and fourth digits. Here we see that thus early we have a suggestion of the ultimate relation of the parts, in that the tendons arising from the palmar fascia leave room below them for fascial spaces between them and the bones. And, again, the early grouping of the tendons corresponds to the spaces; i. e., the radial lateral parts, going to the index finger, and being entirely separated from the two ulnar parts corresponding to the middle, ring, and little fingers. The most ulnar part is not so distinctly separated from the median part as is the radial; that, in a way, being partly fused with the median, but still, both upon dissection and injection, we have noted a partial tendency to separation of the middle and ring finger area from the little finger area. How much the development of the muscular mass of the hypothenar area may have to do with this, is, of course, undecided, since we as yet know little as to its embryological development, but it would seem reasonable to assume that it has little relation, owing to its extreme ulnar position; so that, reasoning *a posteriori*, we would say that in case of the mammalian embryo there had been a persistance of the separation between the index mass and the others, while there had been either an incomplete fusion between the median and ulnar mass, or else they had partially fused as development proceeded.

SURGICAL APPLICATION

Concerning the surgical application of the anatomical and experimental data, we have noted, it should be borne in mind, that our remarks are strictly confined to a discussion of these facts in relation to the subject of fascial space infection of the hand. Lymphatic and synovial sheath infection will be considered only in so far as they have a distinct bearing upon fascial space infection. The French, particularly since the time of Velpeau, have discussed the origin of phlegmons in the hand. Dolbeau, Chevalet, Le Dentu, Gosselin, Roux, and others have attributed the origin to either the lymphatic channels or the synovial sheaths with great positiveness. At the present time it seems advisable to admit that it may take place from either source; but no matter whether the infection follows in one way or the other, the pathological result is the same.

ETIOLOGY

In all of the cases coming under observation the accumulations of pus in the spaces have been submitted to bacteriological examination, and it differed in nowise from the same findings elsewhere, nearly all showing the staphylococcus in pure culture. In only one case so far has the streptococcus been found. In most of the cases which became severe it was noted that the wound was either a deep punctured or badly lacerated wound, or if these were minor, the general health and resistance of the patient were below normal. The latter factor has been particularly conspicuous. On the other hand, cases of localized infection (from deep lacerated wounds) have followed in very robust individuals, where doubtless the infection has been carried directly to the space infected. Again, it has been noted that local trauma, without apparent abrasion of the skin, has acted by lessening the local resistance, and hence favoring infection.

Illustrating these facts, the following case may be cited:

CASE 1. KINGCAID.—Injured September 3, 1904. The sharp point of a meat tong ran into thenar area upon level of extended thumb about two cm. from thenar adductor crease. Pain and swelling ensued the following day. On September 5th, consulted a physician who found much redness and swelling upon the dorsal thenar area and made an incision there, but evidently failed to evacuate the pus. Hot dressings were applied and two days later patient presented himself at the Northwestern University Surgical Dispensary for treatment. There was considerable swelling of the whole hand, but distinctly greater upon the radial side. Dorsal thenar slightly greater than palmar, but upon inspection it was not difficult to see that the thenar area as a whole, was much more swollen than the remainder of the hand. Adduction thenar crease was the dividing line. Thumb metacarpal fully abducted, proximal phalanx semi-flexed, distal phalanx fully flexed, giving an almost spastic look to the hand. The finger phalanges were all semi-flexed. The flexion of the index finger, however, was more rigid than that of the other three, and movement of it and the thumb caused more pain than of the three ulnar fingers. *Both epitrochlear and axillary glands* slightly enlarged and tender. Old incision upon dorsal thenar region from which small amount of pus was exuding—temperature 101°.

X-Ray Plate No. I.—Representing the location of pus in the middle palmar space.

Pulse 90. Tenderness marked over palmar thenar area.

DIAGNOSIS—ABSCESS, THENAR SPACE. Operation. Under nitrous oxide anæsthesia—incision made into thenar area at about the same site as the wound—much pus evacuated. Through and through drainage established to dorsum, perforated tube inserted, hot, moist boric dressings applied. September 7th.—Swelling almost subsided, still discharging much pus. Temperature 99°—pulse 84. Treatment continued. Cultures taken showed—typical staphlycoccus aureus colonies—methlyn blue and Grams stains; Staphlycoccus aureus. September 9th—hand much better, tube removed, hot dressings re-applied. September 11th—hand in good condition—dry dressings applied. Following this patient made a rapid recovery. Seen July 1905. No contraction; function perfect.

I. MINOR INFECTIONS OCCURRING IN INDEFINITE SPACES

Those cases in which the abscess has been found upon the palmar surface, either in the sub-epidermal or the sub-dermal tissue, doubtless owe their origin to the lessened resistance due to trauma more than those developing elsewhere; for here the thickened area of superficial cornified epithelium is frequently opened by cracking, infection ensues in the superficial layers and the repeated trauma of the subjacent tissue so lowers the resistance that the germs in the superficial cracks spread to this area by lymphatic extension, or, if the cracks are deep, by direct inoculation, and find excellent food for development, since the normal resistance found in healthy tissue is absent. Where an abscess develops beneath the derma in the subcutaneous tissue above the aponeurosis it is almost impossible for pus to spread laterally, owing to the density of the surrounding tissue; consequently it ruptures through the deeper layers of the skin and comes to lie beneath the epidermis which is very much thickened, owing to the callus incident to the patient's trade. From here it extends laterally beneath this dense epithelial tissue, making a dumbell-shaped accumulation of pus, a bisacular condition to which the French give the descriptive title, *en bouton de chemise*. If this thickened and resistant epidermis is not present the pus finds ready exit through the inflamed skin, rather than extend deeper through the aponeurosis or laterally to any distance.

In this connection attention should be drawn to the fact that at the lower or distal end of the palmar aponeurosis the sheet may become very thin in spots, particularly between the processes which blend with the tendon sheaths and the superficial transverse ligament, and hence above the canal for the lumbrical muscles. Here by noting one's hand, slight elevations of tissue may be seen, cushions of fatty tissue; when pus accumulates at this point it spreads very easily into the web of the finger and in those anomalous cases where the fascia is lacking to any extent, an infection from the deep part of the palm could spread into this area and thus evacuate itself upon the palmar surface or dorsally in the web. This would probably be rare, but experimental (Experiment No. 28) and clinical evidence can be adduced to prove that it does occur.

In relation to this, two very interesting cases can be cited, showing how infection apparently in nearly the same site may occupy different spaces.

CASE 2 C. B.—Carpenter by trade, has been using a chisel several days in succession almost constantly.

He hits the handle of the chisel with the palm of the hand to force it along. Two days ago patient began to note tenderness at the distal portion of the palm between the base of index and middle fingers about two cm. from web. Upon examination this was found to be tender to pressure and had considerable local hardness. Slight œdema of dorsum. Temperature 99°, pulse 85. Incision was made over area and small amount of pus evacuated. This was under the deeper layers of skin lying upon the transverse fascia in the pad of fat found in this region.

CASE 3. ERNEST ANDERSON—Applied to dispensary, Northwestern, November 5, 1904. Patient noticed pain and tenderness at base of ring and middle fingers, about one and one-half centimeters from web. Swelling and redness had been increasing for four days. Temperature 99°, pulse 86. Local swelling and redness at site noted, involving web also, but most marked above. Tenderness noted as severe.

Diagnosis: Abscess subdermal; above aponeurosis. Operation: ethel chloride spray, and incision made over site of greatest tenderness, down through deep layers of palmar skin. Moderate amount of pus escaped, and upon inserting probe the larger part of the pus was found to be in the cellular tissue of the dorsal web area, one-half inch back from web. Through and through drainage inserted.

November 7th; drain removed—little discharge. November 9th; nearly well. Patient did not return.

Here we see two abscesses, to all appearance in the same place, yet in reality very different, being so near the distal edge of the transverse ligament that while one was confined to the subdermal tissue, the second had invaded the adjacent cellular tissue of the web and spread, by continuity of spaces, into the loose tissue (see cross-section ii) of the dorsum, where most of the pus was localized.

While we are discussing these minor infections of the hand, we must, for the sake of completeness, draw attention to the fact that superficial infection of the epidermal tissue may take place and separation of the epidermal from the dermal tissue ensue over a considerable area, the cavity being filled with a watery, purulent accumulation. This is generally a low grade of infection and frequently follows trauma, or infection of a blister originating from any cause. Staphylococcus albus is said to be most frequently present; in the two cases I have had an opportunity to examine bacteriologically, the aureus was the exciting cause.

In the thenar region several minor and indefinite spaces lie beneath not only the skin, but also the fascia which covers the muscles. The areas are small, however, and are generally opened through the adjacent skin before any serious damage occurs. It is in these areas more often than the thenar space proper, that direct infection from puncture takes place, since the latter lies rather deeply, and to invade it the puncture should enter between the muscular body and the adduction crease, rather than upon the prominent part of the thenar eminence. It is well to bear this point in mind in making a diagnosis, as to whether the thenar space is involved or not, since a minor infection in the superficial tissues of the thenar area may be associated with great œdema upon the dorsum, or even a metastatic lymphatic abscess in the dorsal subcutaneous thenar region, and thus confuse the surgeon and lead to a diagnosis of pus in the thenar space when it is uninvolved. This error occurred in one of my cases, and is of particular interest, as it demonstrates that treatment based upon this improper diagnosis may not produce serious results, since here it will be noted that no disastrous sequelæ followed the opening of the uninfected space in conjunction with an abscess of the subcutaneous tissue.

CASE 4. EDW. KAMLESKI. Injured December 12, 1904, at Stock Yards, by running foreign body into thenar eminence at about middle of palmar surface. All signs of localized infection followed, and upon December 16th patient applied to dispensary for treatment. Diagnosis of infection of the thenar space made, and through and through drainage of thenar area instituted, under gas anæsthesia. It was seen that the dorsal subcutaneous tissue only, contained pus; tube was withdrawn and dorsal opening enlarged. Patient made rapid recovery, and was discharged in ten days, apparently fully recovered.

II. INVOLVEMENT OF THE IMPORTANT FASCIAL SPACES IN THE HAND

A. *Implantation of the injection in the spaces.* The *middle palmar space* is more often infected by implantation, both through direct puncture and extensive crushing injuries and lacerated wounds.

CASE 5. Case crushing injury of hand—fracture of ring finger metacarpal, with infection involving the middle palmar space.

Mr. Birt Pondexter, 6408 S. Carpenter Street, (colored) age twenty-five, Chicago Charity Hospital.

Patient's Statement: Patient states that he was thrown in front of moving car and wheel ran on his

hand, but evidently did not cross it. Condition found upon entrance to hospital following day: lacerated wounds across dorsum of right hand, midway, two and a half inches long, rather deep, into subcutaneous tissue; lacerated wound of palmar surface two inches long, and irregular, so that there was a flap raised up consisting of tissue superficial to palmar aponeurosis; wounds infected; fracture of metacarpal of middle finger; tendons intact; fingers extended; not particularly tender to flexion and extension, although thumb was more tender than others. (This was later found to be due to a fracture of the proximal phalanx.) Whole hand swollen, no particular areas. Flaps opened to allow drainage. Hot boric dressings applied.

Patient's temperature and pulse demonstrated a continuation of the severe infection, and two weeks after entrance, owing to the site of the injury and the greater rigidity of the middle, ring, and little fingers, a diagnosis of pus in the middle palmar space was made. Proximal phalanx extended, two distal phalanges flexed 45° from the same line. Drainage by rubber tube through palm instituted. Rapid fall of temperature and pulse followed. Drainage was free. Œdema and swelling continued for some time, beginning to decrease, however, at the end of the first week.

Jan. 29th (2d day)	Temp. 101½–102⅛	Pulse 70–104
Jan. 30th	Temp. 101 –103¼	Pulse 80–108
Feb. 1st	Temp. 101½–101¾	Pulse 100–108
Feb. 3d	Temp. 99 – 99⅛	Pulse 92–104
Feb. 4th	Temp. 98⅛– 99½	Pulse 80– 92
Feb. 6th	Temp. 99½–102½	Pulse 88– 92
(Here the infection evidently extended)		
Feb. 9th	Temp. 100½–101⅛	Pulse 84– 90
Feb. 11th	Temp. 99¼–104⅛	Pulse 84– 92
Feb. 13th	Temp. 100 –103¼	Pulse 96–124
Feb. 15th	Temp. 100¼–101⅛	Pulse 76– 90
Operation: middle palmar space drained		
Feb. 17th	Temp. 99¼–100½	Pulse 96–100

(Temperature curve begins to fall and septic symptoms decrease. Sleeps well and beginning to eat.)

Feb. 19th	Temp. 99½–101¼	Pulse 92– 96
Feb. 22d	Temp. 99⅛–101	Pulse 94– 96

(Drain removed.)

Gradual fall until upon March 3d, the temperature fell to normal and remained there.

March 20th—Temperature and pulse normal, hand still swollen and little movement in fingers, position of digits same as upon entrance; can move all slightly without pain, index most of all; thumb slightly tender to passive movements (fractured). Other fingers—little pain produced by manipulation. Passive movements begin.

April 20th—Hand improved much, much greater range of movement of fingers; evident that nearly full functions will be restored.

In deciding, however, whether or not the middle palmar space has been invaded by injury, it is well to bear in mind that the space lies dorsal to the tendons and superficial vessels; hence these can be uncovered by a lacerated wound, and the space not necessarily become involved, although it is probably true that unless scrupulous care be taken to give perfect drainage superficially, the space will later become involved, since the fascial sheet separating the tendons from the space is very thin, as has already been pointed out. This same fact is to be remembered in case of a punctured wound, since, while the loose cellular tissue surrounding the tendons, superficial vessels and the lumbrical muscles, would harbor pus for a short time, and if properly drained, need not extend to the space; yet if intervention is withheld for any length of time, it must extend either down along the lumbrical muscles, through the fibrous canal at the distal part of the palm already noted, and thence into the cellular tissue dorsal to the web, (see experiment No. 26), or break into the palmar space, and in nearly every case the latter action will be found to have occurred long before the former.

Owing to the juxtaposition of the metacarpal bones, particularly of the middle and ring fingers, any crushing injury of the hand, with consequent compound fracture of these bones, will frequently lead to infection through this dorsal wound, as I myself have seen. (Case 5.) The metacarpal bone of the little finger, being somewhat distant from the space, is not so likely to open the space, while the metacarpal bone of the index finger, (and in exceptional conditions, the middle finger), will open the *thenar space*. Compound fracture of the thumb metacarpal would more likely lead to dorsal subcutaneous accumulations of pus, or even synovial infection of the sheath of the flexor longus pollicis, than thenar space infection. It is well to bear these predisposing etiological factors in mind when we come to discuss the diagnosis of the position of the pus.

Since few lymphatics lead into the *hypothenar space*, and it is isolated from adjacent areas by densely circumscribed tissue, infection here is due most often to direct implantation. For instance, a palmar infection will rupture into the ulnar bursa or extend, in preference, under the annular ligament, and then rupture into the cellular spaces of the forearm, before

it will overcome the resistant tissue intervening between it and the hypothenar space. (See cross-section No. VII.) The space can be infected, however, from the dorsum, through a compound fracture of the fifth metacarpal, but even there the pus would be more likely to accumulate upon the dorsum, owing to the intimate relation of the hypothenar muscles to the bone, than in the space, unless the injury of the muscles is extensive.

Direct infection of the *subaponeurotic space* can occur by punctured, or incised wounds, or by crushing injuries compounded particularly upon the dorsum. The incised wounds, lying transverse to the tendons, would be less likely to lead to subaponeurotic accumulations of pus, owing to the retraction of the aponeurosis by the extensor muscles, thus opening the gap widely so that free drainage would ensue into the subcutaneous tissue, or externally. Longitudinal cuts, on the contrary, would tend to close, and thus prevent free drainage.

The *subcutaneous tissue* is infected in the same manner. It also can be invaded in the pileous infections occurring upon the dorsum, which at times become carbuncular in their nature, thus extending from the skin proper into the subcutaneous tissue.

B. *Involvement by lymphatic extension.* Besides the direct infection of these spaces, they may become involved by an extension from adjacent injuries, either by the lymphatics, or by continuity of fascial spaces. There is abundant clinical proof now that infection by the less virulent germs can spread by lymphatic channels, and abscesses develop at distant spots. Upon the other hand, it is often impossible to say whether an extension has occurred by means of the lymphatic vessels, or by means of the spaces, and fortunately in these cases it is not necessary to decide the question, since the two courses are generally side by side. Thus, the deep lymphatics pass from the fingers along with the vessels in the same space in which the lumbrical muscle lies, and in a given case, for instance, an infection at the base of the ring finger which spreads into the middle palmar space, who can say whether it extends by means of the lymph vessel or along the lumbrical muscle, going to the radial side of that finger. Moreover, we do not need to know. What is of importance is to know where the pus lies after it has extended, and certainly a study of the course of the lymphatic channels is of importance in relation to this. It is not our purpose to discuss the subject of lymphatic infection as a whole, nor do more than draw attention to monumental work of Sappey,

X-Ray Plate No. II.—Representing the location of pus in the thenar space, with its relation to the ulnar bursa.

Leaf, Malgaine, and others, by which we can, in some measure, prognosticate the position of a metastatic abscess when the point of primary infection is known. The superficial lymphatics upon the palmar surface pursue the shortest course to the dorsum. Thus, for instance, an infection starting upon the distal part of the palm would go between the web of the fingers to the subcutaneous tissue of the dorsum. (Case report No. 4.) Hence, should an abscess develop as a result of this, it would be found in the dorsal subcutaneous area. Should a lymphangitis be present, however, without localized abscess forming, the swelling in this region would be just as great, owing to the œdema which develops

in the loose tissue found here. This will be brought out later in discussing the diagnosis. Should the deep lymphatics be involved, the infection will follow the deeper vessels, hence passing into the palm. Theoretically speaking, then, an infection spreading from the adjacent sides of the little and ring finger, and the ring and middle fingers, would lead to an accumulation of pus in the middle palmar space, while an infection of the adjacent sides of the middle and index fingers, and index and thumb would infect the thenar space. Other infections upon these fingers more dorsal would follow the deep vessels under the aponeurosis upon the back of the hand, thus producing a subaponeurotic abscess. Unfortunately, sufficient clinical evidence has not accumulated to prove these assumptions, although some cases have been reported which tend to support it. Chevalet and Dolbeau particularly, have presented cases showing this complication, especially those showing extension and development of abscesses under the dorsal aponeurosis. The proof of an extension to the palmar and thenar spaces is much harder to demonstrate, for the reasons that have already been pointed out. But holding in mind the accurate outlines of the spaces that we have shown, it is to be hoped that the future will enable us to be more definite upon this point.

Dolbeau has drawn attention to the frequency of infection along the course of the radial in the forearm, due to extension from the thenar region by means of the radial lymphatics. He also notes the presence of abscesses along the ulnar artery and in the deep tissues in the forearm, originating, he believes, by a lymphatic extension along the anterior interosseous. That these all occur is not only possible, but probable, but in this connection the reader will remember the experimental injection of the palmar space where the mass spread, by continuity of tissue, under the tendons into this middle foyer, and then involved, secondarily, both the radial and ulnar areas mentioned, (experiment No. 7), demonstrating that the same clinical sign and pathological condition can be produced by fascial extension as by the lymphatic course, except those cases in which the radial and ulnar foyers are the primary source, or are alone involved.

C. *Involvement by extension through connective tissue spaces, or synovial sheaths.* In discussing the extension by continuity of spaces, as well as the extension from space to space by a rupture of intervening septa, it is well to bear in mind that there would possibly be some difference between the results obtained by injections under force, from which my deductions are made, and the extension of pus under tension. Certain facts are to be borne in mind.

1st. The injection mass lacks the barrier naturally interposed by swelling incident to the engorgement of the tissue, both intra and extra vascular, following inflammation, hence tending to close the natural canal.

2d. These natural canals would tend to become closed by inflammatory adhesions, which would occur if the inflammation were not particularly acute. In this manner the canals about the lumbrical muscles and that leading from the palmar space into the forearm would tend to become closed by either or both of the above-mentioned pathological processes. That this is not a theoretical consideration is proved by those cases in which the swelling of the tendons under the annular ligament has become so great as to produce necrosis at this point, due to pressure of the non-elastic annular ligament. (Forsell.)

3d. The cadaver specimens at times may have undergone some disintegration, and hence the tissue may not have been so resistant as normal lining fascia.

While these facts should be remembered for what they are worth, yet to a certain extent, they are probably more theoretical than practical, since the friability of the cadaver tissue finds its counterpart in the destruction of tissue due to inflammatory processes, and the inflammatory barriers mentioned would be of importance only in the chronic cases.

Let us now take the various fingers and see into what spaces deep purulent accumulations would spread, since it is thus that the cases are presented clinically.

X-Ray Plate No. III.—Boundaries of the thenar and middle palmar spaces marked, and proper site for opening the latter indicated. Ulnar bura and blood vessels injected. Photograph by Dr. Cubbins' Surgical X-Ray Laboratory.

THE SPREAD OF INFECTION INVOLVING THE INDEX FINGER

The index finger having received a severe injury causing a deep infection, we admit that the infection can spread by three methods: (*a*) lymphatic; (*b*) fascial; (*c*) through the synovial sheath. We have already discussed the lymphatic spreading. The *extension by the fascial spaces* is easy to follow when we study the series of cross-sections (Nos. 1, 2, and 3). Here we see there is loose connective tissue surrounding the phalanges in which it could spread with only moderate difficulty; upon the dorsum it might go up into the subcutaneous tissue in the back of the hand. Internally, it would come to lie in the cellular spaces at the web between the index and middle fingers, and could even spread along the lumbrical muscle of the middle finger into the palm, and thus invade the middle palmar space. This, however, would be more likely to occur in a deep inflammation involving the proximal phalanx of the middle finger, if at all; since as a general rule the pus would come to the surface before extending along the lumbrical canal.

Upon the radial side of the index finger there would be still less likelihood of the pus entering the lumbrical canal in preference to coming to the surface, since this canal is not so well marked. Of course it could not extend upon the volar side into the palm, because there is no connecting space. (See cross sections 2 and 3.) Again, we note that if the pus were under the dorsal aponeurosis of the proximal phalanx it would be limited to this area, since it is a closed space and does not communicate with the subaponeurotic foyer upon the dorsum of the hand. Thus we see that while it is possible for the thenar space to become infected by fascial space extension, it is not probable. However, a metacarpo-phalangeal arthritis may develop with destruction of the bone and ligaments. This extension then becomes not only possible, but probable, since the metacarpal bone of the index finger lies in juxtaposition to the space, separated, however, in part, by the adductor transversus. Pus would probably first enter the space between the adductor transversus and the first dorsal interosseous, then into thenar space. (*Vide* experiment.)

The question now arises, however, should the pus lie either primarily or secondarily in the subcutaneous tissue upon the dorsum of the hand in the region of the index metacarpal, could it spread around the radial border of the index metacarpal into the thenar space? Again should it lie in the subcutaneous tissue between the index and thumb metacarpals, could it pass under the web into that space? The study of the cross-sections (Nos. 5, 6, and 7), as well as the experimental injections (Nos. 31 and 32) seem to show that this is not probable. Clinical evidence can be adduced to corroborate this. The pus would rather come to the surface upon the dorsum. The subaponeurotic accumulations, unless complicated by an osteomyelitis, would also follow the same course. (See experiments Nos. 35 to 37.)

We now come to the third method of extension, *by the synovial sheath.* Let us suppose that the synovial sheath has become filled with pus and an extension has evidently taken place into the hand along this sheath. Here the anatomical, experimental, and clinical evidence is clear. (Cross-sections No. 5. Experiment Nos. 17, 18, and 22–30. Case No. 6.) Having ruptured from the proximal end of the sheath, where it is very thin generally, the pus would lie in the loose connective tissue which surrounds this tendon and the lumbrical muscle. After a short time, as the infection persisted, or the accumulation of pus grew greater, it would follow the lines of least resistance, and run along the lumbrical muscle toward the radial side of the index finger (Exp. 18, X-Ray IV), and being limited here, would then rupture through the thin sheet of fascia, separating this tissue from the thenar space, (cross-sections Nos. 5 and 6), and thus become a thenar space infection.

CASE 6. See in the service of my friend Prof. F. A. Besley, at the Post-Graduate Hospital.

Diagnosis. Infected wound of index finger, tenosynovitis of index tendon, infection thenar space, ultimate amputation of finger.

September 2, 1904. TONY WALTERS. Ten days before coming to the hospital the patient cut his finger just above the knuckle joint on a tin can; wound

X-Ray Plate No. IV.—Injection via tendon sheaths of both thenar and middle palmar spaces with considerable force. Note extension into forearm from middle palmar space. Showing where pus would lie in neglected cases, as in Case VII.

slightly to radial side of dorsum. This became infected, and the patient consulted a physician, who opened the wound and passed a drainage tube through and across dorsum, coming out between the index and middle fingers. Upon examination on entrance, the finger was seen to be much swollen, as was the entire hand, particularly the dorsum. Several openings appeared about the proximal phalanx. A probe into one of these found rough bone and easily entered the knuckle joint. The entire finger and hand was slightly tender, but marked and conspicuous tenderness was elicited over the site of the tendon sheath, and sharply limited by it, being most acute at proximal end, over metacarpo-phalangeal articulation. Flexion of finger did not increase pain; extension of index finger caused marked pain throughout finger, but most sharply noted by patient at proximal end of sheath. Extension of other fingers caused little increase of pain; no particular pain on dorsum of finger where cuts were found. Temperature 101°, pulse 92. Infection of foot present also, as well as small boil on opposite shoulder. Epitrochlear and axillary glands swollen out of proportion to those in left arm. (Patient's resistance is evidently far below par.) Systemic symptoms marked. Neutrophilia 94 per cent.

Clinical diagnosis. Infected wound of hand; probably staphylococci; infected index tendon sheath; extension to glands of axilla and elbow and in addition, infection of skin on shoulder and in foot. Etiology of latter unknown—possibly pyæmic from hand; infected knuckle joint.

Prognosis. Will probably lose finger.

Operation. Tendon sheath opened from end to end. Pus in moderate amount evacuated. Dorsal openings previously present enlarged. Hot boric dressing. Foot opened and drained. Temperature ran 99° to 101° every day.

September 9th. Finger shows fluctuation on dorsum of hand just proximal to index finger, and ulnarly. Incision and drainage. Finger not so painful; flexion about same; not so tender; no especial swelling in palm of hand.

September 12th. Infection has extended to thenar eminence; tenderness localized to this area. Swelling marked; palm not involved.

Operation. Inserted forceps into cut on dorsum made September 9th; forceps fell into direct communication volar surface of thenar eminence; opened here; pushed forceps then from volar surface through to dorsum between first and second metacarpals; forceps passed through dorsal skin with little or no resistance; tube inserted.

September 16th. Subcutaneous abscess has developed in radial region of forearm above wrist and above elbow, and over brachial vessels; incised and drained. W. B. C. 18,000.

September 24th. Temperature 99°, to 101°.

October 14th. Temperature has been running 99° to 100° for last two weeks; index finger swollen to four times its normal size; blue, and evidently an osteomyelitis of the proximal phalanx, and a suppurative arthritis of metacarpo-phalangeal joint. *Operation.* Index finger and head of metacarpal bone amputated; drainage.

October 20th. Condition of hand much better.

Following this patient improved rapidly; discharged November 3, 1904. Small area of granulation tissue over amputated area; moves thumb and three fingers three-fourths of normal; wrist joint same; function of all will ultimately be restored.

THE SPREAD OF INFECTION INVOLVING THE THUMB

Infection of the thumb would at first glance seem to offer the most favorable course for pus to extend into the thenar space. But let us consider for a moment. *Lymphatic extension* does offer some chance, if the infection be deep and upon the ulnar side, as

has already been pointed out. Upon the other parts, however, the tendency would be for the pus to be carried away from the space. The *synovial sheath* of the flexor longus pollicis lies some distance from the space, (see cross-section 6), and hence pus would tend to come to the surface if the sheath ruptured in its course. It can be seen, however, that if the sheath ruptured in its distal part, and the infection thus became an infection of the *connective tissue spaces*, it could spread along the ulnar side of the thumb, and by considerable destruction of connective tissue, come to lie upon the origin of the adductor transversus, and thus invade the space. Should the infection be upon the back of the thumb, the pus would extend more easily into the dorsal subcutaneous tissue of the thenar area, while, in all probability, upon its radial side it would point upon the surface.

THE SPREAD OF INFECTION INVOLVING THE MIDDLE FINGER

Here the finger, lying as it does in the dividing line between the thenar and middle palmar spaces, becomes an extremely interesting subject of study. *The lymphatic extension* has already been touched upon. *Extension from the synovial sheath* at its proximal end gives positive results experimentally. (Experiment Nos. 10, 11, and 12.) Since in every case the mass extended into the middle palmar space after rupturing through the indefinite connective tissue, separating it from the space as already described under the index finger discussion. It is to be borne in mind, however, that the lumbrical muscle joining this tendon comes back to pass under the transverse ligament, between the index and middle finger, and that while the tissue intervening between this muscle and the thenar space is firm and experimental injections have failed to rupture through, yet, anatomically, it would seem to be possible in some cases. No clinical evidence can be adduced at the present time to support this assumption. Should the infection be a deep-seated accumulation of *pus in the cellular tissue upon the dorsum*, it could spread subcutaneously upon the back of the hand; upon the radial side, exceptionally along the lumbrical muscle into the middle palmar space, with the possibility of invading the thenar space, as above noted, upon the ulnar side. If it should spread along the lumbrical muscle, it would go into the middle palmar space. (Experiments Nos. 15 and 16.) Subaponeurotic infection would be limited to the phalanx, while *osteomyelitis, involving the metacarpal bone*, would tend to invade the middle palmar space in front, and the subaponeurotic dorsally.

THE SPREAD OF INFECTION INVOLVING THE RING FINGER

Here, there is little doubt about the relation between this finger and the middle palmar space. The extension by the *dorsal subcutaneous* tissue, and the *lymphatic channels* have already been discussed. The *connective tissue spaces* at either side of the finger and in the web of the infected hand, allow the pus to spread through the fibrous canal surrounding the lumbrical muscles and lead into the palmar space. (See Experiments 15, 16, and 26, and cross-sections 2, 3, and 4.)

In making this deduction it should be emphasized again that in a majority of cases pus would be evacuated on the surface before it would burrow through this canal. Hence, it is only in neglected cases that this complication would ensue, unless the extension had taken place by the lymphatic channels which pass through these same canals. Suppuration extending from the *synovial sheath*, would enter this space. (Experiments Nos. 5 to 9, cross-sections 3 to 5.) Primarily, of course, it would lie in the loose connective tissue superficial to the space, spread down along the lumbrical muscles (X-Ray plate I.), especially of the little, ring, and middle fingers, and then destroying the thin roof of the space, would involve the entire middle palmar space. *Arthritis* of the metacarpo-phalangeal joint, with *osteomyelitis* of the diaphysis of the metacarpal, could also infect this space, as well as the subaponeurotic infection on the dorsum. (Case 5.)

INFECTION SPREADING FROM THE LITTLE FINGER

Here the *lymphatic channels* and *connective tissue spaces* upon the inner side of the finger

could pass into the middle palmar space. On the outer and dorsal side they would tend to lead into the subcutaneous tissue externally. The *synovial sheath*, if continuous with the ulnar bursa, would probably rupture earliest in the forearm (X-Ray plate III). If it did rupture in the hand, or if the synovial sheath of the finger is shut off from the ulnar bursa, and the finger sheath ruptured, it would tend to involve the middle palmar space. (Experiments Nos. 13 and 14.)

It might be mentioned here that Chevalet and Dolbeau maintain that a rupture of the sheath is not necessary to extension, but that this can take place from the sheath by lymphatic extension, and they adduce a post-mortem examination in support of their contention. This, however, is an academic question, since the same space would be involved by the extension, and the clinical findings would be identical.

In an *osteomyelitis* of the fifth metacarpal, the hypothenar space would be involved upon the volar surface, and the subcutaneous tissue dorsally. (Cross-section Nos. 5 to 7.)

FROM WHAT SOURCE WILL THE VARIOUS SPACES BECOME INVOLVED

Now let us review the subject from the other viewpoint, that the subject may be clear. Given a distinct space, from what source, in a majority of cases, is it likely to become involved, leaving out of consideration direct implantation of infection? The *middle palmar space would receive infection* from the middle finger, ring finger, and radial side of the little finger, with its synovial sheath. Osteomyelitis of the middle or ring metacarpals would also extend to this space.

The *thenar space would become involved* by infection from the index finger and the ulnar side of the thumb. Osteomyelitis of the index and thumb metacarpals could also involve this space, although it would be possible for either of them to be the seat of disease and not involve the space.

The *hypothenar space* would become involved in an osteomyelitis of the fifth metacarpal.

The *subaponeurotic space would become involved* by an osteomyelitis of the middle and ring finger metacarpals particularly, and at times from the little and index metacarpals. Lymphatic abscesses along the deep dorsal vessels would also lie under this sheet of tissue.

The *dorsal subcutaneous space* communicates freely with the fingers and the thumb.

D. EXTENSION FROM EITHER OF THE FIVE SPACES TO ADJACENT AREAS

We now arrive at the next question that confronts the surgeon. Given a space already involved, what other spaces could it extend to, and by what means? The question now becomes one more of pathology than anatomy, and while the infection still retains its full relation to the anatomical peculiarities of a part, yet the destruction of tissue incident to long inflammation must always be taken into consideration; moreover, the longer one studies the question the more prone he is to ask whether many of the complicating extensions are not due either to inadequate treatment, or an improper idea as to the position of the pus, and consequently the institution of incisions which tend to favor the extension of the infection as much as to give proper drainage.

Let us take the *palmar space*. Here the question of extension has been studied by injection. The pus would have a natural tendency to spread in two ways: first, along the lumbrical muscles of the little, ring, and middle fingers; and thus point, in time, in the connective tissue of the web upon the dorsum; this we know has occurred in long standing cases, in spite of the pseudo closure of the canal at the lower end and its narrowness, which would thus favor closure by inflammatory exudate. (See X-Ray plates, cross-sections 2–4.) Secondly, the pus would tend to pass under the annular ligaments behind the tendons, immediately over the wrist joint, thence into the forearm, lying upon the radius, ulna, interosseous membrane and its attached muscles, and the pronator quadratus; covered by the flexor profundus digitorum, thus filling the entire space from the elbow to the wrist before it comes to the surface laterally two to three inches above the wrist joint. (Experiment No. 7.) This extension would take place in at least two-thirds of the injections of the palmar space if force were used. But now enters

the question of destruction of tissue at the wrist joint, swelling of the tissues under the annular ligament, and the plastic exudate, which would tend to close this natural exit. That this occurs frequently we have abundant clinical evidence.

In corroboration of the experimental data we find the report of a post-mortem done by

Photograph I.—Thenar space. End of pencil showing in its deepest part.

Prof. Dolbeau, and reported by Chevalet in his Paris thesis of 1875. The extension under the synovial sheath, without invading it, and the involvement of the forearm, with its diverticulum along the radial, all makes a picture the duplicate of Experiment No. 7. It will be noted that the pus occupies the exact outlines of the middle palmar space, bathes the free portions of the tendons in juxtaposition to the palmar aponeurosis, and yet it is specifically stated that the abscess cavity laid dorsal to the tendons.

CASE 7. "At the hand the lesion is limited to the middle palmar region; the two eminences, thenar and hypothenar, are intact. In the middle palmar region the aponeurosis is raised with some difficulty, the tissues infiltered with plastic matter, form a thick layer as if lardaceous, in the deep part of which are plunged the superficial palmar arch and the terminal ramifications of the median nerve.

"These organs being dissected and raised, one begins to uncover the tendons in their palmar portion, and in order to be able to examine them in their whole length, the annular ligament of the carpus is incised.

"The sheath of the tendon of the long flexor of the thumb is intact in all its length, at the thumb, at the palm of the hand, under the annular ligament, and above this ligament the cul-de-sac by which it terminates. Let us recall that it is upon the thumb that the initial wound is found, the point of departure of all the trouble. But the sheath of the flexor longus pollicis is absolutely intact.

"In examining the ulnar sheath one finds the following: the portion of this sheath destined to cover the tendons of the superficial flexor is little altered, and these tendons, save that of the little finger, are relatively intact. The portion of the sheath destined to the tendons of the deep flexor is much more diseased, especially at the level of the tendon of the little finger. In examining the sheath of this tendon, one finds it intact in its digital portion. The tendon presents there its mother-of-pearl appearance, and is absolutely sound. But if one follows it to the palm of the hand, one sees it penetrate into a purulent foyer, which occupies the deep part of the hand. The tissue about bathed in pus is diseased. Likewise the tendons which it envelopes for a stretch of about 4 cm. of the tendon of the little finger, of 2.5 cm. to 3 cm. of the other tendons, index, middle, and ring. Above this point the sheath and the tendons take again their character of integrity and keep it in the carpal canal, even to the terminal cul-de-sac of the sheath.

"In raising the tendons of the deep flexor, one begins to uncover a purulent foyer occupying the profound palmar region, situated exactly upon a median line (*par rapport*) in relation to the axis of the hand, and corresponding exactly to the deep palmar arch that one sees placed against its posterior wall Its anterior wall is formed by the sheath of the deep flexor tendons that it flooded over. It is prolonged the length of the sheath of the tendon of the little finger, had opened it and the pus had penetrated and traversed it in such a manner as to come to show itself beneath the palmar aponeurosis; but, a thing to notice, it had not spread into this sheath, neither at the lower part, toward the little finger; more in the upper part in the carpal canal.

"The radial-carpal articulation is filled with pus; its cartilages are destroyed, the osseous surfaces which supported them are eroded. The triangular ligament partly destroyed allows the radio-carpal articulation

to communicate freely with the inferior radio-cubital articulation.

"The articulation of the first row of the carpal with the second is in the same condition; likewise the articulation of the bones of each row between them, especially of the first. What is the origin, what has been the mode of production of this suppurative arthritis of the wrist? It is a question not easy to decide, but that which can be affirmed is that the lesion so limited by the sheath has not been there for nothing, since this sheath is intact at the level of the articulation.

"In dissecting the forearm, one is struck, first of all, by the apparent integrity of its anterior region. The lesions are, in fact, very deep. Alone, the sheath of the radial vessels appears diseased, from the first inspection. It is, in the inferior half of the forearm region, infiltrated with a plastic matter which gives to it the appearance of a whitened cord with granulated surface. The artery, plunged in the middle of this plastic matter, is detached from it only with difficulty, and by dissecting it with care. The sheath of the ulnar is intact; the median nerve presents nothing at all particular; the muscles are intact also, at least those of the superficial layers, because in dissecting the deep flexor one finds beneath it, or rather in its thickness, in front of and inside of the ulnar bone, a purulent foyer of about the volume of a small egg. This foyer, situated at the middle part of the forearm, well limited below, at least upon the anterior region of the forearm, is without communication with the lesion of the palm of the hand, and with that which we shall see presently, exists at the level of the pronator quadratus. In seeking what has been its point of departure, one finds it at the side of the ulnar bone. This latter has been the seat, in its inferior half, of the suppurative periostitis, and is almost totally denuded, even to the middle of its length. The foyer that we have just indicated is a tributary of the subperiostal foyer which bathes the bone from the back and the inside. The origin of this periostitis appears to have been the rupture of the articulation full of pus, which was opened from the back.

"In raising, at the wrist, all the tendons, the flexors, one begins to uncover a second foyer situated between these tendons and the pronator quadratus. This muscle, altered, but not destroyed, separates this foyer from the ulnar bone, so that there exists no relation between it and the osseous lesion. On the contrary, this foyer communicates by the proper canal, behind the sheaths of the tendon, with the foyer of the palm of the hand."

We now ask ourselves, what are the probabilities for extension when these normal exits are closed—in what way will the inflammatory destruction of barriers show itself? The pus cannot break through the firm palmar aponeurosis. We first turn our attention to the adjacent thenar space. We remember that the lower, or distal, portion is very firm, but that at the proximal end the dividing tissue is rather thin, and it is very easy to suppose that the infection may destroy the intervening tissue, and thus invade the radial side. Experimentally, this can be seen to occur. (Experiment No. 9.) This, however, would not occur until late, since most of the pus is at the distal part of the hand. Again, the pus might extend along the lumbrical muscle of the middle finger, and rupture from here into the thenar area. Upon the hypothenar side there is so much tissue intervening between the middle palmar space and the hypothenar that we would not expect this to become involved, only in exceptional cases. Text-books all tell us that the pus in these cases finds exit between the metacarpal bones, and thus escapes to the dorsum. When one studies the dense layer of fascia spreading from bone to bone, both upon the volar and dorsal surface, being really an anterior and posterior interosseous membrane, with the interosseous muscles between, and a division between them being often difficult to find, we are led to wonder if this complication really occurs as early in the course of the disease as we are led to believe. Whether often the œdema upon the dorsum may not have been mistaken for pus, and the spurious corroboration obtained by through and through drainage, misinterpreted. By no means can it be denied that at times, later in the course, the pus does find this means of exit. When it does, it first comes to lie in the subaponeurotic, and then in the subcutaneous tissue.

Another course of extension is sometimes seen in which the ulnar bursal sheath is destroyed, and pus thus entering the sac, spreads along the tendons and ruptures into the forearm in the same space we have already described in relation to extension by fascial spaces.

Suppose our *thenar space* is primarily involved; the pus here does not so readily extend into the forearm. (Experiments forcible, Nos. 22–30.) Here probably the weakest place lies toward the dorsum, either above or below the adductor transversus, thus invading the tissue between the thumb and index metacarpal, and between the adductor transversus and first dorsal interosseous, where there is a large, cone-shaped cavity. (See

Experiments Nos. 22–28.) It should be borne in mind, however, that this result is not obtained easily, since the pus will often remain for days confined to the thenar space. (Case No. 1.) In long continued, or anomalous cases, it can spread up along the lumbrical muscle of the index finger, infect the loose connective tissue about the palmar tendons, and thus infect the palmar space, or can rupture through at the upper end. (Experiments Nos. 24, 25, and 26.) This complication should be rare, however, in properly treated cases.

In case the *subaponeurotic space* is infected by extension from the palmar space or otherwise, there might be considerable variation in the course the pus would pursue; if the sheet is dense, as it is in a majority of cases, the suppurative process would tend to extend under the aponeurosis and point laterally, upon either side, at the thinner tissue there, thus becoming subcutaneous, or at the distal margin between the metacarpo-phalangeal joints as I myself have seen. However, at times, there are thin places between the tendons, and then the purulent matter would become subcutaneous through this small opening. In all probability, however, before either of these things happen, operative interference will have opened the abscess. (See photograph 4.)

PATHOLOGY

In discussing the pathology not already elaborated in the previous paragraphs, it should be remembered that we are restricting ourselves strictly to that phase of the subject having a relation to the anatomical and experimental studies preceding. Consequently, to do more than mention the arthritis in the wrist, the osteomyelitis of the metacarpals, and the destruction of tissue and fistulous sequalæ, would be out of place. We should, however, draw attention to certain consequences of suppuration in the individual spaces.

Let us ask ourselves what would be the after results of infection of the middle palmar space alone, the tendon sheath not being opened. We shall divide them into primary and secondary; and under the caption of primary, attention should be drawn to the fact that the scar tissue following such a process, would involve particularly the tendons of the middle and ring finger, with the lumbrical muscles of the middle, ring, and little fingers. Consequently, it is in these fingers that we would expect to find the most persistent adhesions and contraction; and it is in consequence of the disturbed circulation in the blood-vessels going to these fingers that long persisting œdema and nutritional changes occur, augmented somewhat, probably, by impaired nerve supply.

Secondary sequalæ are noted in the associated œdema and changes in the index finger and the thumb, and while these are severe, they are not of such high grade as in the others. These changes are most marked in the index finger, and are due to the juxtaposition of the tendons and the intimate relation of the circulation. Moreover, the ulnar bursa, with its contained tendons, is adjacent to the area of infection; consequently, there is the probability of a low grade of inflammation within. Again, the corollation of movement between the tendons determines

Photograph II.—Middle palmar space. End of pencil lying in its deepest part.

approximately the same position for the index finger as the others. This constant position, associated with an effusion into the joints, leads to adhesions of the articular surfaces in all the fingers, the thumb least of all, since the tendon of the thumb is well separated from the site of infection. Should the process extend to the thenar area, the index finger would then be in the same condition as the other fingers. On the other hand, if the infection were primary in the thenar space, the most disastrous changes would ensue in that finger, while the other three fingers would suffer only the secondary changes, but fortunately not so severe as the secondary changes were in the thenar space when associated with palmar infection. This is owing not alone to the comparative size and complexity of the areas, but also to the fact that thenar abscesses are sooner recognized and drained more perfectly; consequently the process is not so disastrous.

Should the subaponeurotic space be involved primarily, or by an extension from the palmar space, secondary adhesions take place, and the whole sheet becomes more or less immobile as a consequence of the movement of all the extensor communis tendons.

SYMPTOMS

The symptoms and signs may be divided into local and general. The general evidences of this variety of infection do not differ at all from those seen elsewhere. The temperature often reaches 103° to 104°, and the restless tossing of the patient, the sleepless nights, the wandering eye, the sweaty brow, and the flushed cheek, all demonstrate the absorption of the toxines, bound in closed spaces with no means of exit.

Locally, one elicits particular pain over the area involved. This localization of the pain is not so definite, however, as that noted in synovial sheath infection, particularly in those patients in whom the mental equilibrium is disturbed as a result of suffering and septic intoxication. Unfortunately the brawny induration so helpful in diagnosing subcutaneous accumulations of pus cannot be so definitely elicited upon the palmar surface, owing to the palmar fascia and its general rigidity. Upon the dorsal surface, however, the induration and localized tenderness will aid us materially in distinguishing between the doughy, pitting œdema, which is always present, and an accumulation of pus, long before fluctuation gives its tardy evidence. The position of the fingers is worth noting. Incident to any inflammatory process about the hand, with its consequent œdema, the fingers

Photograph III.—Thenar space, opened widely.

tend to become flexed, here, however, the flexion of the fingers is neither so marked or rigid as in synovial sheath infection.

If the middle palmar space be involved, we are often aided in making the diagnosis by the site of the primary injury. Since, under the caption of etiology, the routes of extension from various fingers and parts of the hand were pointed out, it is not necessary to go into detail upon this subject again, although an example may be given. For instance, in Case No. 5, the palmar surface was evidently involved. The fistulous tract on the dorsum opened over the metacarpal bone of the hypothenar area dorsally; but remembering that the metacarpal bone of the middle finger was fractured and infected, and also bearing in mind the fact that pus in the subaponeurotic space would tend to point at the side, a diagnosis of pus in the middle palmar space was made, rather than the hypothenar. Drainage of this space was instituted, and the imme-

diate fall of the temperature, with rapid convalescence, substantiated the diagnosis. Tenderness most marked over this area, with swelling of the whole hand, marked upon the ulnar side, (or it is better to say without the excessive swelling of the thenar area which characterizes infection of that space), aid us in making the differential diagnosis. Attention is drawn to the relative swelling of the thenar and palmar areas, since in palmar infections the swelling of the two might be almost the same, owing to the rigidity of the palmar fascia over the one and its absence over the other. On the contrary, however, infection of the thenar area is characterized by a much greater swelling in the thenar than the more resistant palmar tissue; and, moreover, the swelling of the thenar region is greater than that due to the collateral œdema of mid-palmar infection.

The position of the fingers does not aid much, although, theoretically, we would expect the middle, ring, and little fingers to be held in their characteristic positions more markedly than the index. It is well to remember that the fingers can be moved from their position with much less pain than can those fingers involved in a teno-synovitis. The slight rigidity of the thumb, in contradistinction to its involvement in thenar infection, also aids us in making the differential diagnosis between these two spaces. The great difficulty in making the diagnosis, however, is not in those cases in which the question is only—Which space is involved, it is when we ask ourselves, Are they both involved? or when we wish to know whether a mid-palmar space infection has spread over into the thenar space, or vice versa. Fortunately, however, the thenar space infection does have, to a certain extent, that induration which has been spoken of as being absent in infections under the palmar fascia, and which aids us, slightly at least, to differentiate between collateral œdema and pus in this space. Moreover, the history helps us some. Given a primary palmar space infection for several days, we note a rapid increase of the size of the thenar area, the œdema upon the dorsum, which has not been so great as that upon the ulnar side of the hand, becomes greater; the palmar surface swelling becomes very marked, the tissues of the thenar area seeming to balloon out, as it were, from the adduction crease of the thumb, the metacarpal is pushed away as far as possible from the hand, and the flexion of the distal phalanx becomes more marked, although lacking the rigidity of synovial infection of the flexor longus pollicis; we now fear an extension into that space.

Photograph IV.—Scars showing where subaponeurotic abscess has pointed. Note four openings at the edge of the aponeurotic sheet. Note prominence of tendons, i. e., suppuration beneath.

The extension of an infection from the thenar to the palmar space is not so common, fortunately, since diagnosis is made earlier, and the proper treatment instituted.

Involvement of the hypothenar space can often be prognosticated from the site of the primary injury, while the relative lack of swelling in the palm and fingers, with absence of involvement of the tendons, combined with the ordinary symptoms of abscess, lead us to an easy diagnosis. Fortunately the hypothenar area is so separated from the remainder

of the hand that it is not frequently involved, secondarily, to palmar infection.

An infection localized under the subaponeurotic fascia to the exclusion of the subcutaneous tissue may be difficult of differential diagnosis. However, we are aided materially if we remember the character of the primary injury, the methods of extension to this space already mentioned, and the local evidences of infection upon the dorsum, with the pitting œdema of the subcutaneous tissue, yet lacking the brawny induration and localized tenderness of a subcutaneous abscess.

Reference has been made already, to the œdema upon the dorsum, due to the fact that there we find a large area of loose subcutaneous tissue in which serum can accumulate, and secondly, to the anatomical distribution of the superficial lymphatics, which, as we have pointed out, all seek the shortest course from the palmar surface to the dorsum. Consequently one often finds much greater swelling upon the latter than the former, even though the abscess be upon the palm. If, however, we bear in mind the soft pitting of œdema, with its generalized moderate tenderness, as opposed to the slight pitting and localized tenderness of the swollen indurated abscess in this tissue, the diagnosis is easy.

It is not within the scope of this paper to go into an extensive discussion of the differential diagnosis between infection of the synovial sheaths and the fascial spaces. It suffices to draw attention to acute tenderness localized in the area of the synovial sheaths in the former, which is absent in the latter. Again, in the one the fingers are rigidly flexed, and in the other the flexion is not so marked or so rigid. Acute pain is developed upon extending the fingers in the first, while in the last, as a rule, movement of the fingers causes only moderate pain. Theoretically, the swelling should be most marked over the area involved, be it tendon sheath or fascial space; but practically, this may not help us much. In the synovial infection the wrist is held much more rigidly than in the fascial infection; there is frequent swelling above the wrist over the area of the synovial sheath in this infection, while in the other that is absent, unless the forearm has become involved; fistoulus tracts connecting with the spaces are said to be less frequently present, or at least to develop much later in the former than in the latter. In fact, the presence of numerous discharging sources is said by Bauchet to be so common in the latter condition that he has compared the condition found to a purulent sponge. At times either infection may pass over into the other type, and the diagnosis of this extension may be very difficult, and must be based upon the symptoms suggested in the present paragraph.

It is well at this time to speak briefly of those cases which extend into the forearm. We remember that this is much more likely to occur in the palmar space infections than in the thenar infections (see expts.), although cases are reported in which it has extended from either. (Chevalet.) Here we would note the sudden increase of evidences of inflammation in the forearm; the temperature would rise, the tenderness over the forearm in front grow greater, and the swelling become more marked; but owing to the fact that the pus is deep under the muscles induration would be absent until later, when the whole area became involved, and it would tend to come to the surface probably a few inches above the wrist, along the vessels.

Exception must be made of those cases already noted where the infection develops about the radial and ulnar arteries, probably of lymphatic origin. Here the abscess is not so deep, yet is considerably below the skin in the area of those vessels.

Osteomyelitis, arthritis, and other complications and sequelæ have no peculiar relation to fascial space infection, and hence will not be considered in the symptoms, diagnosis, and treatment. They will be reserved for a subsequent paper.

PROGNOSIS

The prognosis varies, of course, with the kind of infection, length of time it is permitted to continue without proper treatment, and the resistance of the individual, as well as the complications that are present and the spaces which are involved. The average infection, properly treated, will often give surprisingly good results; function may even be almost completely restored in an infection of the palmar space (Bau-

chet) if persistent after-treatment is instituted. Infection of the subaponeurotic space is also liable to give rise to adhesions between the tendons and its subjacent tissue, so that the condition which is hardest to deal with in its late stages, is that in which both the palmar and subaponeurotic spaces are involved.

Infection of the thenar space, owing to the probable early diagnosis and treatment, should give good results, while treatment of the dorsal subcutaneous and the hypothenar areas should give a good prognosis as to function. It is seldom that these infections jeopardize life or necessitate amputation unless complications are present. Extension to the forearm should be looked upon with anxiety, and if serious complications or sequelæ are present, the patient must be warned that the course may be long, and the ultimate restoration of function depend much upon continued and faithful application of after-treatment.

TREATMENT

The treatment naturally divides itself into prophylactic and active. In the first instance all wounds should be cared for with aseptic care, and any localized infection should be attended to, thorough drainage being instituted before they have a chance to spread. In those cases in which we are waiting to decide whether or not a localized abscess is present, immobilization and the local use of the well-known hot, moist dressing is probably more efficient than any other application. The usual general tonic and excretory procedures may be instituted.

Should the diagnosis of a localized accumulation of pus in any of the various tissues be made, we naturally ask what is the best site for incision, for we need not discuss the proposition that such a condition as that demands early and efficient drainage. Should the subcutaneous tissue of the dorsum or the areas under the epidermis or derma of the palm be involved, or those minor infections of the thenar and hypothenar areas be present, a wide opening by simple incision is generally sufficient. Should the middle palmar, thenar, or subaponeurotic spaces be involved, however, some special consideration is necessary. The opening of the middle palmar space is a grave responsibility; the diagnosis is difficult, and upon the other hand, the danger of delay is great. It is probably better to err upon the side of radicalism, however, than conservatism, owing to the liability of complications in the ulnar synovial sheath, the bones, and joints.

Any method of opening the space exposes certain tissues to injury, and it is a question of choosing the least dangerous route. It cannot be opened upon the ulnar side, owing to the fear of infecting the ulnar bursal sheath, a flap of the palmar fascia cannot be dissected up from below, as has been suggested to me, making a sort of a trap door, as it were, since the infection lies below the tendons, and to make such an opening, then drain anteriorly between the tendons, would result in most serious adhesions. Consequently, we come back to the method of through and through drainage, from palm to dorsum. True, this infects the dorsal subaponeurotic space, but in all probability there will be little spread in this if drainage is good.

We now ask ourselves where the incision should be made to give the most satisfactory outlet to all the diverticula, and at the same time injure the fewest structures. Here the value of our X-Ray plates, with the cross-sections, and injections, is invaluable. (See plates.) We see that the mass always lies over the interosseous space, between the ring and middle finger, and that an opening here will drain all the pockets. Our incision, however, must lie proximal to the superficial transverse ligament. (See cross-section Nos. 3–5, X-Ray plate No. III.) Secondly, it must lie to the radial side of the ulnar bursa (X-Ray plate No. II), and must be to the ulnar side of the middle metacarpal. This again throws the incision into the metacarpal space, between the middle and ring finger. Thus we see that not only are the fewest structures injured by this site, but also the most perfect drainage is instituted.

Now let us consider where an incision should lie in this space. An examination of X-Ray No. III plate shows the deep palmar arch running across this area, at the upper end; the fine lines drawn transversely represent the dense tissue of the superficial transverse ligament, while the curved lines represent the palmar creases. It is thus seen that at the point where the middle palmar crease crosses the metacarpal space

should be the indicated site for drainage. Making a cut here through the palmar aponeurosis, and then forcing a pointed artery forceps through to the dorsum, being careful to rupture the dorsal aponeurosis freely, we draw through a large, perforated rubber tube. At this site there is little danger of a pressure necrosis of the ulnar bursa or the palmar arches.

Should the thenar area be involved, the indications for radical operation are absolute, even upon less evidence than in the case of palmar infection, since here the dangers of delay are greater, and the consequences of opening the space, even though uninfected, are not serious. (See Case No. 4, in which space was opened when uninfected, under mistaken diagnosis.) Here the pus lies either anterior to the adductor transversus, or upon both its dorsal and palmar surface. Theoretically, the most available place to open would lie to the radial side of the index metacarpal, where a free incision would drain both in front and behind the adductor. This, of course, would cause a scar, involving the thenar index web, and in contraction might possibly limit movement. Therefore, since we know that drainage through and through the thenar area from palm to dorsum is efficient, safe, and followed by no complications and few sequelæ, that is probably the route of choice. It should be remembered, however, that the space lies to the ulnar side of the thenar eminence; consequently the palmar opening should lie to the ulnar side of the muscular body, and not through it, emerging on the dorsum at about the level of the metacarpo-phalangeal articulation of the thumb, midway between the two metacarpals. A rubber drainage tube having been inserted, there is little likelihood of any extension of the infection.

If the subaponeurotic space be involved, we should remember that the tendons proper in the lower part of the dorsum overlie the metacarpal bones, except the tendon going to the little finger; consequently our incision should lie over the interosseous space. Moreover, any deep transverse incision, if too long, would cut the tendon, while a simple longitudinal incision would tend to close. Therefore, in making our incision and drainage, these two factors should be taken into consideration, and an adequate opening provided, which does not injure the tendon.

If the infection has spread up under the annular ligament into the forearm, the pus will lie beneath the tendons of the flexor profundus and upon the pronator quadratus. The best method of emptying this abscess would be to go laterally, just anterior to the radius, about three inches from the wrist. After making the skin incision, an artery forceps is pushed through the deep tissue, going between the flexor profundus tendons and the bone. Should the cavity be opened, a wide incision can be made, and the pus evacuated through one opening, or through and through drainage can be instituted, the tube passing just above the ulna. If the incision be made at this point and in this manner, the tube will lie posterior to the radial and ulnar vessels and nerves; they will be protected from pressure necrosis, and, in addition, the least tissue would be destroyed, while the freest drainage is instituted. If the abscess be a subcutaneous lymphatic extension, simple incision is all that is indicated. In relation to drainage, it need not be said that if it is impossible to secure free exit by simple incision, our best choice of drainage device is a rubber tube, since gauze is not at all satisfactory in purulent accumulations.

After any of these procedures, the usual hot, moist dressings are applied until we feel that extension of the process has ceased, when they should be abandoned, since the continuation of the enlargement of the vessels incident to their use results in increasing œdema, and ultimately lessening resistance, owing to improper circulation; hence they become a menace to the part rather than a help. At this stage elevation of the part will be found to be of material aid. Immobilization should be kept up as long as there is any danger of muscular action disseminating the infection. As soon as this stage has passed, however, active and passive movements should be encouraged, with the idea of assisting in the absorption of the excessive œdema, as well as assisting in the prevention of tendon and joint adhesions. As time goes on and the infection has practically disappeared, the patient should be anæsthetized frequently with nitrous oxide, and the persisting adhesions destroyed, while in the intervals between such violent procedures

the patient should be taught to manipulate the fingers and hand by both passive and active movements, using the hand preferably in some occupation which will give a constant action, and therefore produce much more favorable results than a few moments devoted each day to passive movements, which the patient does in an unsatisfactory and inadequate manner.

DIAGNOSIS AND TREATMENT OF RUPTURE OF THE UTERUS.[1]

By GEORGE SCHMAUCH, M.D., CHICAGO.

WE wish to define rupture of the uterus as follows: tearing of the uterus above the vaginal portion, occurring spontaneously or by violence during labor. We shall also consider in this definition utero-vaginal tears, excluding, however, according to Koblanck, those common cervical tears, which are the consequence of extraction or abnormal uterine activity before the cervix is completely dilated. Perforation of the uterus resulting from pressure shall not be mentioned as properly belonging to the ruptures.

Next to sepsis and eclampsia rupture of the uterus has the greatest mortality during labor. The varying interpretation makes it appear quite natural that statistics regarding its frequency should vary likewise. It is also influenced by the pathological percentage of cases in the various hospitals. The Berlin Frauenklinik shows a frequency of 1:462 in 37,000 labors. Iwanoff of the Moskau maternité reports 1:961 cases in 118,000 labors. The proportion of home cases is 1:1,428. As a general average the proportion will be 1:1,500. This coincides with the statistics of Ehlers in Berlin, which are based upon death certificates. He gives in 1895, 48,000 labors with 11 ruptures, in 1896, 50,000 labors with 5 ruptures, respectively, 1:4,000 and 1:10,000. Basing these reports upon a mortality of 60 per cent, we do not quite obtain the above-named figure, namely 1:1,500. It has to be taken into consideration, however, that the practitioner rather states the ensuing peritonitis as cause of death, than the rupture.

Cervix tears occur of course more frequently. The complete perforating ruptures are found about four times as often as the incomplete ones. The mechanism of rupture is but a partially explored territory. Even the post-mortem specimen does not always aid us to differentiate between primary tear and secondary prolongation. Likewise in practice, we often find it difficult to separate spontaneous ruptures from those caused by violence. The force necessary to cause the rupture is reduced to a minimum in a uterus, which is, so to speak, "ready to burst," and may be represented by a careless examination or a sudden change of position.

As to the form of the tear, it makes no difference whether they occur spontaneously or by violence. Indeed, the most severe and irregular tears including, for instance, the bladder, occur spontaneously. Undoubtedly this is caused by the tremendous difference in pressure, a change of highest tension to complete relaxation at the moment rupture occurs. This sudden release produces the same effect as the snapping of a tight cable, followed by the most deleterious results for everything adjacent; for example, rupture of the bladder, total exposure of the colon, detachment of the peritoneum up to the spleen.

The mechanism of the typical tears of the lower uterine segment, expansion-tears, has no opponents to-day. It represents the teaching of Bandl, and the results are the so-called Bandl's tears. The symptoms of overdisten ion, the ascension of the contraction-ring and its oblique course, the tension of the round ligaments even between the pains, form the trio which enables the obstetrician to forestall or diagnose the rupture.

We can speak of overdistension, assuming the uterine walls to be normal, only after rupture of the membranes and complete

[1] Read before the Chicago Gynecological Society.

dilatation and effacement of the os. A maximum tension does not come under consideration as long as the vaginal portion has not become part of the distented lower uterine segment. In case we have unyielding cicatrices of the cervix, the mechanism of the typical tears undergoes deviations. A circular tearing of the portio often follows.

According to Bandl, rupture during labor will occur under the following conditions, namely, when the presenting part meets abnormal resistance, either by its own size, by contraction of the pelvic inlet, by obstruction of the pelvis by tumors, or by mal-positions, such as oblique and transverse presentations. Contracted pelvis is by far the most frequent cause. Weidling and Lehmann show that there is one rupture of the uterus to one hundred labors in contracted pelves.

The normal, well-formed uterus, destined by nature to carry and deliver the child, hardly ever tears spontaneously. We find in the literature but a very few cases of spontaneous rupture in primiparæ and these are not entirely free from objection. Kliehn mentioned 5 spontaneous ruptures in primiparæ, among 347 cases, all above 30 years of age. Schmit's report from Shauta's clinic contains no primipara in 28 ruptures. Koblanck cites one rupture in a woman who had borne one child, among 22 spontaneous ruptures.

As far as the normal uterus is concerned we can say: no overdistention, no rupture. The picture changes, however, when nature or human hand has created a predisposition. One previous overdistension causes lasting damage, a persisting reduction of the vitality of the muscle-cells, furnishing a predisposition to rupture. H. W. Freund has shown that overdistension causes deficient involution, this in turn produces a state of atrophy. In studying the statistics you will find rupture frequent in 7 to 15 paræ. Predisposition as a causative factor in rupture, emphasized by Olshausen, Freund, and Fritsch, is now generally recognized. Not every case shows histological changes, nevertheless we must consider it a general rule, that spontaneous rupture of the normal uterus without previous injury must be regarded as an exceedingly rare occurrence.

A previous overdistension of the lower uterine segment during protracted labor is, however, not the only cause of a subsequent rupture. Extensive gynæcological surgery, confident of momentary results, has created a number of predisposing factors. These are: the rupture following fixation of the uterus for correction of mal-position, rupture following cæsarean section, extensive cervical incisions, so-called Duehrssen's incisions, (Hofmeier 2, Labhardt 4 cases), amputation of the portio, (Velde 4 cases), adnexial operations with cuneiform excisions, (v. Fellenberg), the use of Bossi's dilatator, Tarnier's ecraseur, perforations of the uterus by probe and dilatator, and last, but not least, the curettage of the puerperal uterus. Every lesion of the uterine muscles leads to a permanent loss of substance. Repair takes place, not by reformation of muscular, but connective tissue, as shown by Askanazy in 1892, and lately confirmed by Marchand. This process produces a locus minoris resistentiæ.

The typical rupture of Bandl, affecting the lower uterine segment, takes place in the overdistended uterus, before the presenting part has passed the pelvic brim. Those cases where rupture occurs after the head has entered the true pelvis, or even is visible at the vulva, when the largest part of the child has left the uterine cavity, can be explained in this manner only, that the tear occurred in an old scar, or rather represents the final enlargement of a previously existing fissure. The resistance of the pelvic floor furnishes merely the missing link. The participation of the vaginal fornix in spontaneous rupture depends entirely upon the tension of the vault and the tearing force. Utero-vaginal tears are found with comparative frequency in impacted transverse presentations and pathologic anteversions (pendulous abdomen), because here the tension of the vaginal vault is very marked.

Any portion of the uterus having undergone pathological changes may tear at any stage of labor. Localization depends entirely upon the place and kind of pathologic changes, causing the predisposition. In consequence a rupture of the fundus may occur

under these circumstances, although rupture of the fundus occurs as a rule, during pregnancy.

We also see ruptures in the third stage of labor. These are always caused by violence, and are mostly the results of manual detachment of the placenta. Oswald has collected nine cases, which were produced chiefly by midwives. However, even the most skillful operator may meet with this accident. We may encounter such firm adhesions between placenta and uterine muscle, that separation is possible only with considerable loss of substance. Abnormal insertion of the placenta in a naturally less resistant portion of the uterus, for instance, at the tubal openings, or over a scar, operative or inflammatory, or abnormal decidua-formation, so-called decidual metastases, may lead to rupture. These conditions decrease the normal resistance to such a degree, that the tissues may give way spontaneously or to a mild force during manual detachment of the placenta. Rupture has even occurred with a forced Crédé, as the case of Schwendner shows. The peculiar arrangement of the muscular fibers of the pregnant uterus in lamellæ, their imbrication, the connection of the longitudinal by oblique lamellæ, render the occurrence of a tear in a normal corpus almost impossible.

We differentiate between complete and incomplete ruptures; in other words, those with or without opening of the peritoneal cavity. Observations that the peritoneal covering *per se* also may tear, date back as far as 1875. Later observations show that these so-called peritoneal fissures may become external, incomplete tears, involving the greatest part of the musculature down to the intact decidua. This variety may terminate fatally by hemorrhage. This again raises the question, in which zone of the uterus does the typical tear originate. It was the universal belief that the peritoneum tears last, because it is more elastic than the muscle. This opinion requires some modification. A differentiation is essential between those parts of the uterus where the peritoneum is but slightly attached, as the region of the bladder and the parametria, and those parts where the peritoneum is closely adherent to the underlying muscle; in other words, where the muscle fibers insert directly at the peritoneum, as in the posterior and upper portion of the uterus. Individual variations certainly exist. There is no doubt that the muscle tears first in the former variety. Here the tear, if not occurring too suddenly, produces a hæmatoma. It is evident that an incomplete rupture of this variety with formation of a hæmatoma may be transformed into a complete one by the joint action of uterine pains and the presence of the accumulated blood. A nice illustration of this is furnished by the cases of Krebs and Goth, where the appearance of a hæmatoma in the region of the bladder led to the erroneous assumption of a distented bladder, when the rupture became manifest by the sudden disappearance of the tumor. However, this process is exceptional. The usual modus is rather such, that the hæmatoma when it complicates a complete rupture, is of secondary nature, caused by the opening of subperitoneal and parametrical vessels. A spontaneous rupture causing an incomplete tear becomes very rarely complete, for, at the moment rupture has occurred, the principal condition of tearing, namely, overdistension, disappears.

In the second variety, where the tear has its origin above the internal os, in a portion of the uterus, whose external layers are closely united to their peritoneal covering, the peritoneum must tear first. Here formation of a hæmatoma is impossible. The fact that with distension of a hollow viscus the outer layers, in this case the serous covering, gives way first rests upon physical foundation. Knauer's four cases of external, incomplete rupture substantiate this theory. In three of those the distension of the uterus was still increased by premature detachment of the placenta. The individual muscle fibers behave in these cases like any overdistended muscle. The tear does not take place in the center, but at the point of insertion, which is represented here by the peritoneal covering. It appears feasible that timely delivery could prevent the completion of such a tear into the cavity of the uterus.

The etiology of uterine rupture should receive a more detailed consideration, because

the conception of the individual symptoms is impossible without it. You will therefore permit me to discuss the value of the classical symptoms of rupture from an etiological standpoint.

The diagnosis of uterine rupture during labor is made when we find that the above-mentioned symptoms of threatening rupture are followed by the symptoms of rupture proper. Bimanual palpation will confirm this diagnosis by the findings. We find the symptoms of threatening rupture only in those cases of spontaneous rupture where a normal uterus has been subjected to labor for an excessively long period of time, as in obstructed labor. The ratio between presence of symptoms of imminent rupture and the number of preceding labors is inverse. The larger the number of previous labors, the shorter the period between occurrence of rupture and onset of labor. The same holds good with ruptures occurring in old cicatrices, no matter what their origin. In multiparæ or woman where an anamnestic possibility of pathological changes of the uterine muscle exist, diagnosis must be based upon the symptoms of rupture proper, in the absence of those of overdistension.

The following symptoms pertain to the child as well as to the mother. To the former belong the suddenly occurring mobility, the retraction of the presenting part, and the palpability of fœtal parts outside of the uterine cavity. These are by all means the most striking of all symptoms of rupture of the uterus, if labor has been conducted by one person. The forelying part may deviate if great disproportion between it and the pelvic inlet exists and come to lie in the iliac fossa. An improper posture may lead to a deviated vertex presentation. When, however, the fœtal head has entered the pelvic inlet and has been fixed by a number of pains after rupture of the membranes, a retraction will occur only by elimination of the *vis a tergo;* in other words, the contracting uterus. This is possible only by abnormal distension and relaxation of the uterus, produced by accumulation of blood in its cavity, premature detachment of placenta, or by rupture. The natural tonus of the uterus, present also between pains is absent, likewise the intrauterine pressure is altered in both cases.

Premature detachment of the placenta causes an increase of intrauterine pressure and the fœtus becomes movable by the increase of the uterine contents. Rupture of the uterus renders intrauterine pressure negative. In complete rupture mobility of the presenting part is such that it remains in the position placed by the examining hand, without returning to the pelvic inlet.

This symptom is less pronounced in incomplete ruptures, and is seen less often in impacted transverse presentations than in vertex presentations.

The palpation of parts of the fœtus external to the uterus is a pathognomic symptom. In woman with thick abdominal walls anæsthesia is often required to elicit it. Palpation of the abdomen of a woman with rupture of the uterus is not always easy, on account of the *défense musculaire.* In other cases the small parts of the child are felt alarmingly plain. The presence of the contracted uterus besides the fœtus, facilitates differentiation from a thin-walled uterus.

As soon as rupture has occurred and the child has passed into the abdominal cavity in part or whole, placental circulation is disturbed so seriously, by the change in intrauterine pressure, that as a rule the child dies. If rupture occurs during operative delivery, the child may live.

The surrounding of the child by intestines changes the percussion note to tympany, on top as well as laterally. The detachment of the placenta may lead to a prolapse, if the presenting part permits it. Even experienced obstetricians, called in after occurrence of rupture, have been misled by this detachment of the placenta, and diagnosed placenta previa, or prolapse of the placenta. With a sufficiently dilated cervix the condition of the presenting part will make the diagnosis possible. Not so in rupture of the fundus uteri or in insufficient dilatation of the os. Here diagnosis is either impossible or made too late.

The second cardinal symptom is the hemorrhage. This may be external, sub or intra

peritoneal. Only very sudden and violent tears tend to open large vessels. Rupture in old cicatrices or in defects of the muscular substance occurs very gradually. It begins with a small separation, increasing slowly. The opening is filled by the escaping fœtal parts, and there is almost no hemorrhage on account of the anæmic state of the cicatricial tissue.

A 5 para, moderately flat rachitic pelvis, rupture during two last deliveries, first, spontaneous rupture, complete tear of cervix, craniotomy; second, induction of premature labor, high forceps delivery with deep incomplete laceration of the cervix; treatment both times drainage of the tear, good recovery, became pregnant again. Upon examination I advised cæsarean section and told her to report every month; she was instructed to enter the hospital as soon as labor began. As her pains started in absence of her husband, she had to wait until he came home. About an hour after the beginning of the pains she knocked at the door of our confinement hall; she had walked to and from the carriage and did not complain. Regular uterine contractions, but not severe, membranes intact. On account of danger of a rupture, preparations for laparotomy were hastened. This proved justified. Opening the abdominal walls we noticed the anterior wall of the uterus to be torn for a distance of twelve cm. From this tear protruded a very peculiar sight, the white shoulder of the child. There was hardly any blood in the abdominal cavity. By enlarging the opening of the tear, a strong and living child was extracted easily. The sterilizing of the patient was naturally indicated, but she kept her uterus, and recovered without complications.

The soft and weakened wall of a uterus of a 12 or 15 para, may tear in a similar manner, without much hemorrhage. The place of tear also influences the hemorrhage; lateral tears with injury to the uterine artery cause a formidable hemorrhage, while the tears of the posterior wall are usually not followed by much bleeding. In tears with irregular edges, hemorrhage ceases soon, whereas torn vessels exposed by the tear bleed excessively. In such cases fatal hemorrhage may occur, often as late as the sixth or seventh day, by detachment of the thrombi.

External hemorrhage is the chief symptom of incomplete rupture. We may find it as a continuous stream, or a mixture of blood and amniotic fluid may gush out upon lifting the head during examination. The mobility of the presenting part is not so pronounced in these cases. Danger of fatal hemorrhage is relatively greater in incomplete than in complete rupture; 61, 5 per cent; 34, 4 per cent (Koblank). Aside from placenta previa and hemorrhage resulting from torn fœtal vessels within the membranes, premature detachment of the placenta will have to be excluded. The objective findings will guard against error in this respect. The darker color of the blood, its intermittent escape during the pains, and above all the distented uterus speak for a premature detachment of the placenta. As this condition occurs much less frequently, rupture should be considered first and excluded.

In complete tears the external hemorrhage may be associated with marked internal hemorrhage. To prove the presence of free blood in the peritoneal cavity by percussion in various positions will succeed in but few cases. The diagnosis of internal hemorrhage during labor in term is based chiefly on general symptoms. Incomplete tears are often accompanied by subperitoneal hemorrhage, leading to hæmatoma. This may be mistaken for the bladder, as mentioned before. Palpation will reveal a peculiar doughy tumor next to the uterus. As a rule the hæmatoma is formed during labor, but in some few cases it may arise post-partum. Late hemorrhage during the puerperium in connection with hæmatoma furnishes certain proof of incomplete rupture, not recognized during labor. These hemorrhages may be very sudden, surprising the puerpera when she leaves the bed to void urine, as I have personally observed in one case.

The subperitoneal ante-uterine emphysema is of course pathognomonic for rupture. It occurs chiefly in incomplete rupture, but may be present also in complete tears. In case of bladder-involvement, no urine is secreted, and catheterization yields but a few drops of bloody urine.

Another classical symptom is the cessation of pains after rupture. This also has to be taken with a grain of salt. The opinion of former times was, that at the moment of rupture, nature stops the pains as a sort of self defense. At present this view requires modification. All larger tears, especially those of the transverse variety, must as a matter of

course be followed by cessation of pains, as the conditions for regular pains, consisting of a certain intrauterine pressure are not present. Nerve tracts are also interrupted. This does not apply to longitudinal and incomplete tears. The observations are numerous of spontaneous expulsion of the child after rupture. I have reported such a case where after correction of a face presentation, rupture occurred, which was not diagnosed. The child was born spontaneously, the woman died of peritonitis, and only at the autopsy a complete rupture was discovered. In addition, I may remark that regular pains may exist, but are not felt as such by the parturient, from lack of intrauterine pressure.

As a third, we have to mention the general symptoms, the signs of internal hemorrhage, and the statements of the parturient. At times an intelligent parturient will say, that she has felt a piercing pain at the height of a labor pain, that she feels as if something had torn internally. Others state that the child which was already low down has receded. Simultaneously the seat of rupture, excepting those of the posterior wall, which are not accessible to touch, becomes very sensitive to palpation.

More or less pronounced symptoms of collapse are present in every case of rupture. It must be ascribed chiefly to the loss of blood, and secondarily to shock, depending upon how much of the child has escaped into the abdominal cavity. It is wrong, however, to defer the diagnosis of rupture until collapse occurs, because successful treatment will be instituted too late. The pulse changes earliest; without apparent cause it becomes small and frequent. Pallor of the face, coolness of the tip of the nose and extremities, fainting spells, cold perspiration, anxiety, yawning, air hunger, fear of death, in short, the symptoms of a grave acute anæmia, show later. The more sudden these phenomena occur the more striking they become. A sudden collapse in a parturient previously entirely well, will arouse every obstetrician. It is different, however, when a woman has been in labor for days and her general condition is low, or when rupture occurs during anæsthesia. All ruptures due to cicatrices and defects, or in old multiparæ, take place without any stormy symptoms whatsoever. They have been justly called "latent ruptures" by H. W. Freund. In my own case, cited above, the woman was able to walk to the delivery room without complaint. Kamann reports a case of a 12 para, 37 years old, with a longitudinal tear from the vagina up to the tube. She was apprised of her condition only when she noticed hemorrhage upon urination. Many more cases of this kind could be enumerated.

The value of each symptom is commensurate to the order of my enumeration. Their presence renders the existence of rupture very probable. Positive proof is obtained only by the objective findings on bimanual palpation. Strict asepsis is necessary, sometimes a light anæsthesia required. The findings are simplest in the utero-vaginal tears. The tear is also easily found in cephalic presentations on account of the receding of the head. Obstacles are greater in impacted head and transverse presentations. The examining hand can not pass the forelying part in these cases, hence the diagnosis will have to be based upon the symptom complex. The same applies to rupture of the fundus, with the exception of those cases in which the greater part of the child has left the uterine cavity. In cases of rupture with the presenting part above the inlet, the vagina seems elongated, the lips of the cervix are hanging down relaxed, especially in annular tears. When the vaginal portion is not included in the tear, the os may even collapse.

An absolutely positive diagnosis of complete perforating tear can be made in those cases only in which a greater part of the child is in the abdominal cavity, or where omentum or intestines prolapses through the tear. In the majority of cases the diagnosis of rupture *per se* must suffice, to be followed by immediate delivery. Examination after delivery will reveal the form of the tear and the involvement of the peritoneum. It is very difficult to find one's way among the masses of blood and torn muscles, to which often membranes of the ovum are still adhering. One is easily deceived by the thin peritoneal layer, and imagines he holds the

intestinal loops in his hands, while they are still covered by the elastic peritoneum.

An unexpected hemorrhage during the performance of high forceps, version, or craniotomy makes the event of violent rupture highly probable. During version there are only two ways in which a considerable hemorrhage may be brought on. Either the placenta has been separated in the attempt or we have to deal with a rupture of the uterus. A suddenly appearing mobility of the fœtus points with great certainty to laceration. If during a difficult version a sudden hemorrhage occurs, and turning becomes suddenly easy, rupture is likely to have happened. As rupture may occur without alarming symptoms, and the torn uterus may continue its work, we always have to consider in multiparæ rupture of the uterus as the possible cause of post-partum hemorrhage. Successful treatment during this stage of labor depends solely upon an early diagnosis. The sooner we find the cause of hemorrhage the more hopeful we can be of the outcome of our treatment. Expression of the placenta by Crédé and cessation of the hemorrhage, will alleviate the fears of the obstetrician at once. It is different, however, when hemorrhage continues with a well-contracted uterus. No other possibility remains than rupture, if retention of a placental cotyledon can be excluded. The diagnosis is to be made by digital exploration of the cervix, with rubber gloves. As this procedure is associated with danger of infection, it should not be undertaken before exclusion of all other causes of hemorrhage. Beyond doubt many incomplete tears are never recognized because they produce a temporary hemorrhage only and heal without reaction. Only subsequent labors may cause graver disturbances. On the other hand, a portion of the cases of sudden death after delivery are undoubtedly due to tears, which pass unrecognized. Almost one-third of all deaths in placenta previa are due to hemorrhage from cervix tear. According to the statistics of our Berlin hospital, tears of the cervix after version in placenta previa are six times as frequent after the most careful extraction, than in spontaneous expulsion. In very rare instances disappearance of the ligated cord within the vagina, as reported by Puppel, leads to the diagnosis of rupture. More often it is the unsuccessful Crédé, which forcing one to manual removal of the placenta in continuous hemorrhage, discloses the presence of a rupture. Rupture of the fundus will be diagnosed post-partum only by digital exploration of the uterus.

In discussion of the treatment of uterine rupture we will casually remark, that a suitable prophylaxis is first and foremost. As to the therapy of existing rupture, Zweifel is undoubtedly right in stating that one-fifth of all cases die of hemorrhage untreated, either on account of wrong diagnosis or unsufficient treatment, due to external circumstances. Danger of fatal hemorrhage and sepsis furnish the indications for treatment.

Before active interference in rupture, the parturient must be delivered in a quick but careful manner. Mutilating operations are here first in order. Craniotomy in head presentations and embryotomy in impacted transverse presentations. Forceps as a rule are of no avail, because the non-engagement of the head, which caused the rupture, does not permit their application. Version is indicated, if a foot can be reached easily and only a smaller portion of the child is within the abdominal cavity. Removal by laparotomy is indicated when the child is entirely, or to a greater extent, in the abdominal cavity, likewise in absolutely contracted pelvis or tumors obstructing the pelvic canal. External palpation and the size of the uterine cavity inform us how much of the child has escaped into the abdomen. The placenta is usually detached and may be carried a great distance by the peristalsis. In case it does not follow the extracted child, we have to find it, by using the cord as guide. Craniotomy on such an extremely movable head is at times very difficult. In the presence of considerable difficulty and with a possible occasion of laparotomy, one should desist from further dangerous attempts. With hemorrhage possibly fatal, the nature of the tear becomes second consideration, and prevention of exsanguination stands in the foreground. In a hospital with the facilities for immediate laparotomy, that is within fifteen or twenty

minutes, manual compression of the abdominal aorta, with tying of the thighs, and eventually a temporary tamponade, are usually sufficient to meet momentary danger. In the home we transfer the woman immediately to a table with good illumination. The vaginal portion is exposed by large specula, pulled down by vulsella, and the bleeding branches of the uterine artery clamped when possible by stout forceps. Suture of the wound may follow in uncomplicated tears. A prolonged search is useless. If the bleeding portions are not easily reached, tamponade of the tear should be instituted at once. If the parametrium, the usual source of continuous bleeding, is opened, we must also pack it. Compression of the uterus in anteflexion against the symphysis and the vaginal tampon by means of wads of cotton and bandaging will prove a valuable adjunct in anterior tears; in posterior tears fixation in retroflexion is employed.

The further treatment depends upon purely external circumstances. If a hospital is within reasonable distance, transfer after packing is to be insisted upon because of secondary hemorrhage. If skilled aid is of ready access, laparotomy in the home is to be preferred in case of excessive hemorrhage, whenever the surroundings permit it. The danger of transportation of a woman with even a well-tamponed uterine tear is about equal to a laparotomy performed under aggravated circumstances in a home. In the absence of any possibilities for transfer to a hospital or operation at home, the physician will have to deliver by natural route, and be content with tamponade, even if the child has escaped into the abdominal cavity. Very strange occurrences are reported in the literature, as, for instance, where a physician used the cotton of a bedquilt for tamponade, and his patient recovered. Quick and appropriate action gives better results under such circumstances than long, inactive waiting for assistance. The country practitioner cannot be expected to be prepared for laparotomy in every obstetrical case, nor can the knowledge of a perfect technic for such an operation be demanded of him. Tamponade is at present considered equal to laparotomy, if external circumstances do not allow its performance. In less severe hemorrhage, or its absence in incomplete tears, the physician in private practice or country will choose tamponade for obvious reasons. For tamponade aseptic material should be used, sterilized iodoform or silver gauze. It is to be introduced with the speculum if possible. Hæmatomata should be evacuated, the gauze introduced should fill the tear and eventually the parametrium. A tamponade of the uterus is needed only to the extent it aids the packing of the tear. It should remain 5 to 6 days or longer, and be removed piece by piece. An ice-bag placed upon the abdomen relieves the pain. Absolute rest is indicated to the exclusion of even the slightest movement. Peristalsis is arrested by opiates, and the bladder is emptied by catheterization. Tympanites is often present and annoying, and is combated by strychnine and atropin. Irrigations are indicated in incomplete tears only. These tears frequently heal without special treatment when not infected. The first large collection of rupture of the uterus by Kliehn (347 cases), showed the drainage by rubber tube gave better results than simple gauze tamponade. However, tears producing serious hemorrhage cannot be treated with simple rubber drains. Here hæmostasis is the first duty. Gauze and rubber tube may be used simultaneously at times.

The controversy regarding drainage or operation must at the present time be decided in favor of circumstances governing the action of the physician.

Operations to be mentioned are:

1. Transperitoneal method, with incision parallel to Poupart's ligament, applicable only in incomplete tears.

2. Suture by vagina, only in incomplete and easily accessible tears.

3. Vaginal hysterectomy, used in anterior and posterior tears, and in fundus-rupture. It is well indicated in older multiparæ and infected cases; it is easily performed and well stood by the patient. Unfortunately it can be employed in a small number of cases only. Lateral tears, and those involving the bladder, obscure the field of operation in such a way to such an extent that this operation has to be discarded in favor of laparotomy.

4. Laparotomy is the classical operation for

rupture of the uterus. It is done with less danger of infection than tamponade, and allows of better orientation than any other method; offers the best results in the hands of a conservative surgeon. If early performed, it is the best safeguard against fatal hemorrhage. It is the only method by which the blood accumulated in the abdominal cavity can be removed. Treatment by drainage exposes to danger of decomposition of the blood-clots, although this may not be paramount to sepsis. The sooner laparotomy is performed, the better the results; violent ruptures for this reason give better result than spontaneous, because they are earlier diagnosed. In a well-appointed hospital infection during operation can be avoided nowadays with certainty. The results were different twenty-five or thirty years ago. Karl Schroeder of Berlin, who was about the first to treat rupture of the uterus with the child in the abdominal cavity by laparotomy, had eight deaths with eight cases, and in consequence, instituted treatment by drainage in 1880. He employed rubber T-drains, 30 cm. long, which were introduced far up into the abdomen, and this enabled him to save a few of his patients. The only contra-indication for laparotomy is a manifest infection, and this only in absence of marked hemorrhage. If the latter is present, a laparotomy offers still better chances than tamponade. The presence or absence of infection depends upon the number and experience of the examiners. The infected patient presents a slightly icteric hue, with a pinched expression more marked than that produced by an anæmia. The chief advantage of laparotomy consists in the possibility of complete toilet of the abdominal cavity, and the conservative treatment of the ruptured organ. Painstaking hæmostasis, the removal of all clots and liquid blood with the patient in a horizontal position, or if possible, in half-erect posture, facilitate the recovery.

Some authors favor supravaginal amputation, others total extirpation, on account of its simplicity. Supravaginal amputation preserves the architecture of the pelvic floor, and often permits the woman to menstruate. On the other hand, the sound and non-infected corpus is removed, while the lacerated cervix remains. Hence total extirpation is more serviceable when the vaginal portion is torn and has to be sutured. Even amongst the champions of operative treatment at present there is noticed a more conservative tendency. If possible, the uterus should be preserved. In circular tears and those with markedly contused edges, this procedure is of no avail. The advice to remove the uterus in case of infection is not very feasible, as we possess no precise signs of this condition. In general we shall resort to total extirpation more readily the longer the time which has elapsed since rupture, while we will favor conservatism in simple wound conditions and "clean" cases; i. e., not examined. Quite commendable seems the proposition of Zweifel, who in markedly anæmic women simply sutures the serosa after hæmostasis. This is doubtless the most simple operation, and may be combined, if necessary, with excision of the tubes and their uterine insertions.

Literature of the last four years shows the report of twelve cases of conservative laparotomy in uterine rupture. They are the cases of Freund, Stroganoff, Leopold, Torngreen, Veit, Kuestner, v. Guerard, Wiener, Kaman. They were all except two primary laparotomies, one of the latter secondary laparotomies died. To this number we may add ten cases of Zweifel, with suture of the serosa and two deaths. Total number, twenty-two cases with three deaths; i. e., 13.6%. Hereby it is proven that conservative surgery with proper selection of "clean" cases gives very good results.

With the question if a case is "clean" or infected, we have to consider drainage. To decide this question one has to be aware of the fact that neither laparotomy, tamponade, nor drainage protects against existing infection. If infection is present, extirpation of the uterus is not equivalent to an absolute elimination of the source of infection. It does not protect against "autoinfection," for sufficient wound surfaces remain for the streptococci to invade. Drainage removes superfluous secretion, prevents its accumulation and subsequent intoxication, but does not bar the spreading of pathogenic micro-organisms by the lymphatics. Drainage of peritoneal cavity after laparotomy is in consequence not absolutely necessary. It is indicated only in doubtful cases or incomplete toilet of the abdominal cavity. Otherwise vaginal

drainage of the superitoneal wound surface will suffice. Large hæmatomata must always be drained after removal of the clot. Peritoneal defects are to be covered by adjacent organs if repair is not otherwise possible. In laparotomy hæmostasis is the first principle, then follows the repair proper.

Mortality rate of uterine rupture is still very high. Incomplete tears certainly give a better prognosis than complete ones. The conclusions in this paper are based upon the result of the large European University hospitals, and especially the Berlin Frauenklinik. You find them collected in Schmit's paper. However, these statistics date back to the year 1880, a time when laparotomy was still a dangerous operation.

There are 246 cases of complete and incomplete rupture:

K. v. Braun, Vienna, 19.....	Recovered	7
Koblanck, N. Berlin, 80.....	"	21
Deckner, Königsberg, 9	"	3
Tauffer, Budapest, 43	"	17
H. Ludwig, Vienna (Chrobak), 9.	"	4
Schmit (Schauta), 19.....	"	10
To these I have added:		
DeLee, 10 cases	"	4
v. Walla, 28	"	9
Zweifel, 29	"	16

Summary, 246 cases, recovered, 91.

That means a mortality of 63%.

This rate, according to Schmit, is reduced to 58.26%, when those cases are omitted which died without treatment or during operation.

The only modern statistics at present in our hands are those of Schmit, who is an adherent of the tamponade treatment; 19 cases, 1891–1900, with a total result of 47.37% dead, or when the cases which died during operation are deducted, 44%.

Operative mortality, 50%.

Drainage mortality, 38.6%.

A report from Krebs (Toporsky, Posen), of 10 cases of complete rupture, principally all operated, 1898–1904, gives a mortality of 50%.

The individual reports as found in the literature of the last four years, comprise only complete tears.

I found 74 cases, with a mortality of 32.43%.

58 laparotomies, 17 dead = 30%.

16 tamponades, 7 dead = 43.7%.

The question of conservative surgery in rupture of the uterus has so far only been discussed from the point of view of saving time and avoiding infection. Literature of the last few years reveals a number of cases in which the previously ruptured organ, or the uterus subjected to cæsarean section, has suffered from a new laceration during the following labor. There are 29 cases of rupture following cæsarean section to be found in the literature at hand. They are: Kruckenberg, 21 (most of these were not sewed properly); Olshausen, 2 (1 before Saenger's method of suture was used, and 1 afterwards, out of a number of 180 cases treated this way); Everke, Wagner, Munro Kear, Eckstein, Targett, Meyer, 1.

Spontaneous and traumatic rupture occurring before labor had set in, are not included. No reference is made to those cases in which imminent rupture of the uterus furnished the indication for the second operation. I find reported 34 cases of rupture of a previously torn uterus. Couvelaire, 9 ruptures in 17 cases of labor at term after previous rupture; i. e., 53%; Penham, 4; Labhard, 2; Kriwsky, Peters, Alberts, Dittel, Wenzel, 1 each.

These reports prove distinctly, that cæsarean section as well as tearing in some cases totally destroy the fitness of the uterus for subsequent labor, and in most cases diminish it considerably. Whether the improper method of sewing or a deficient union of the wound surfaces is the cause of tearing after cæserean section, is difficult to decide. Some reports of repeated cæsarean section show that the serous covering only was united, whereas, in others no sign of the old incision was to be found at all.

However, it would be premature to conclude that the uterus after rupture or cæsarean section is absolutely unfit for labor. We are not justified by these reports in declaring total extirpation of the uterus as the only proper procedure. There are a number of reports made which show that a prematurely induced labor, and even labor at term, were brought to favorable termination for mother and child.

The possibility of a subsequent labor will always depend upon the extension and place of the tear. Especially laceration of the lower uterine segment incline more than others to

rupture. A scar at this site is as shown by H. W. Freund, drawn inside the cavity of the lower uterine segment, and therefore prevents in some way the normal formation and extension of the lower uterine segment, and might keep the head from descending, as observed by Stroganoff, since the cicatricial tissue lacks the normal fixation which the rest of the uterus enjoys.

The same consideration leads to the conception that vaginal cæsarean section, when performed by one incision, is liable to interfere with the function of the lower uterine segment in succeeding labor. At present there are no confirmations of this apprehension.

Furthermore, we will have to conclude that the classical cæsarean section for relative indication, a relatively frequent operation now days, owing to our confidence in asepsis, will have to be more restricted in future, in favor of the more conservative lateral section (pubiotomy), which leaves the bearing organ intact.

Whoever, after rupture of the uterus, intends to save his patient from the possibility of pregnancy and its subsequent perils, should content himself with resection of the tubes and adjacent uterine tissue. Even most complicated tears will heal by conservative treatment as proved by many reports. The decisive factor will always be the presence of infection.

In case a woman becomes pregnant after previous rupture, premature labor, labor at term, and cæsarean section will have to be considered. The condition of the individual case, the form, place, and mobility of cicatrix, the desire of the woman to have more children, will decide our procedure. Abortion is very rarely indicated. When there is any endangering distension present, we will resolve readily upon cæsarean section. Premature labor commonly gives good results in labor after rupture, but we should guard against a too hasty use of overlarge colpeurynters, since they might produce a new laceration. In general we may say, that we will be compelled to draw upon our entire store of obstetrical knowledge and art in these cases, make the labor as easy as possible for the woman, and deliver her instrumentally as soon as there is a possibility of a harmless delivery, be it by forceps or extraction of the child.

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INTUSSUSCEPTION

REMARKS UPON THE SURGICAL TREATMENT WITH THE REPORT OF A CASE OF SPONTANEOUS REDUCTION AFTER TEMPORARY ENTEROSTOMY [1]

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SPONTANEOUS reduction of an intussusception is undoubtedly rare. Some writers have maintained that slight temporary intussusceptions are more common than is generally supposed, but there is little evidence in support of this view. Certainly the typical cases, in which the diagnosis can be made clinically, seldom end in this way. Whether or not many attacks of colic in children are owing to slight intussusception, cannot be proved. But spontaneous reduction in a case which shows the typical symptoms and signs of the so-called "inflammatory" intussusception—pain, fecal vomiting, distention, currant-jelly stools, and tumor—is rare, indeed.

By *spontaneous reduction* is meant only the unfolding of the bowel into the original form of a single tube. This does not include that form of natural cure which takes place by gangrene and sloughing of the intussusceptium. Instances of this process are comparatively common.

In the following case it seems impossible that a mistake in diagnosis could have been made, for the small intestine was firmly invaginated into the large, as was demonstrated to the entire satisfaction of many members of the staff of the Massachusetts General Hospital, and of a large audience. The case, in brief, was an invagination of the small intestine into the large; failure of reduction by very moderate traction; enterostomy; recovery from operation; death from pulmonary complications; and painstaking autopsy at which no signs of present or previous intussusception could be discovered. It seems to me almost incredible, that the condition present at operation could have left practically no signs perceptible at autopsy. That there was an extensive invagination of the small intestine into the large—an apparently hopeless wedging of the one into the other—admits of no doubt whatsoever. An abstract of the case, taken from the Massachusetts General Hospital Records (Hospital No. 141487; Autopsy No. 1333), is as follows:

CHARLES SMONGE, four years of age, living at 21 Sheafe Street, Boston, was taken with vomiting and pain on February 16, 1905. From that time until his admission to the Massachusetts General Hospital, at noon on February 25th, the boy had vomited and cried. There had been small movements of the bowels during this time. The patient was well developed and well nourished, but looked very sick. The respiration was 35; the pulse 124; the temperature 100°. The leucocytes numbered 6,000; the heart and lungs were normal; the abdomen was everywhere distended and tympanitic. Through the thin abdominal walls, intestinal peristalsis, coming on in intermittent spasms, was distinctly visible. In the left side of the abdomen a resistant, sausage-shaped mass was easily palpable. Nothing else abnormal could be felt in the abdomen. A small amount of liquid fecal matter was found in the rectum. There was constant regurgitation of black fluid, apparently fecal. The diagnosis of intussusception was made, and the child prepared immediately for operation.

The general condition was so bad that the immediate prognosis was grave. In view of the long duration of symptoms and of the evident intestinal obstruction, it seemed unwise to try reduction by hydraulic pressure or by other non-operative measures.

Under ether the tumor of the intussuscipiens and the intussusceptum could be unmistakably felt. Neither the history nor the physical examination gave ground for the least doubt as to the diagnosis. The condition had lasted so many days that reduction of the invagination did not seem possible, even if more force were used than is usually regarded as advisable when the vitality of the gut is questioned. In previous operations I had seen serious, if not irreparable, injury follow these attempts, and I was determined that in the present case the success of the operation should not be jeop-

[1] Read before the American Surgical Association, San Francisco, 1905

ardized in this way. Not only in intussusception, but in a great many strangulated hernias, I had seen unfortunate results from too forcible taxis. In the latter cases I had learned to content myself with the gentlest manipulations. So in the present case I had planned before opening the abdomen not to make any but the most careful efforts at reduction.

My first error in this case was in not trying the effect of moderate hydraulic pressure through the rectum; the second was in not making greater efforts to reduce the invagination after the abdomen had been opened.

The child was so small that the abdomen could be almost entirely covered by my hand. A median incision showed at once the correctness of the diagnosis: the small intestine had been extensively telescoped into the large. The constricting ring of entrance was in the left upper quadrant; the tip of the intussusceptum at the left pelvic brim. The descending colon was about the size of the wrist. Into the constricting ring of the intussuscipiens the mesentery of the small intestine was so tightly drawn that the tense band characteristic of the lesion was conspicuous to sight and perceptible to touch.

The peritoneum of the colon (intussuscipiens) was unchanged. It was smooth, glossy, and without that tense and cracked appearance which I had seen in previous cases. There were no adhesions between the opposing peritoneal surfaces of the intussuscipiens and the intussusceptum. Gentle traction on the small intestine permitted the escape of a small portion of the small intestine, with relaxation of its mesentery. The method by which traction upon the small intestine is exerted with one hand, while with the other the mass is "milked" back, was not tried. In view of the subsequent events, I am sure that I did not give the child the best chance to recover. I was, as I say, prejudiced against the possibility of reduction, having hitherto failed to accomplish it.

The correctness of the diagnosis was, as I have said, evident immediately upon opening the peritoneal cavity. A little free fluid, a tense edge of mesentery, a small intestine disappearing into the large, a sausage-shaped tumor in the large intestine extending as far as the pelvic brim—made the condition unmistakable. The amount of intestine invaginated was estimated to be at least twelve inches, for the mass extended from the left upper quadrant to the left pelvic brim.

The child did badly under ether; indeed, it seemed at one time as if death were impending. It was evident that that procedure was indicated which would give relief in the quickest, if not the most effective way. Efforts at traction, resection of the intestine, and all other time-taking operations were abandoned for the simple and rapid, though temporary relief of an enterostomy. A loop of intestine was therefore drawn from the peritoneal cavity and held in position by means of a pair of hæmostatic forceps thrust through the mesentery, while the rest of the incision was closed.

This procedure appeared, upon careful consideration afterwards, a sensible means of giving not only temporary relief, but permanent cure, by permitting the invaginated gut to become gangrenous and exfoliated by the rectum. I regretted that I did not sew the small intestine to the large at the constricting ring; for the operation, with the relief afforded by the enterostomy, would insure, it seemed, a cure not only certain but safe. It seemed reasonable enough to conclude that the opposing peritoneal surfaces would adhere to each other and that the gangrenous loop would become separated and expelled.

The child was put to bed alive, but in a very feeble condition. In the course of a few hours there escaped from the wound a small loop of intestine which required reduction and suturing. The bowel was then opened. The enterostomy soon became well established. The child, however, though taking nourishment well, gradually lost strength. A purulent bronchitis developed, with respirations gradually increasing from 35 to 70. Death took place on March 16th, twenty-eight days after the initial symptoms and nineteen days after the operation.

At the autopsy a purulent bronchitis was found, with a fibrino-purulent peritonitis. Not only was there no trace of the intussusception to be found, but no evidence whatever, appeared to show that there had ever been an

intussusception. Dr. Oscar Richardson was unable to make out the seat of the invagination, the position of the constricting ring, local changes in the peritoneum, or any other indications of the lesion which had undoubtedly existed. Had there been the least doubt of the existence of an intussusception, we should all have said that from the abdominal condition found at the autopsy, no intussusception could possibly have been present.

I had always been opposed to the medical treatment of this lesion, because I had seen the evil effects of injections. Moreover, in the few cases that I had operated upon, it was impossible, mechanically, to reduce the invagination. Intussusception is, however, a very unusual disease. No one man can see much of it. The present case shows the folly of drawing positive conclusions from one's own necessarily limited experience.

I have felt since the findings of the autopsy that in this case, medical treatment might have succeeded, for there was nothing to be overcome except the contractions of the large intestine, which alone held the intussusceptum; that with a little more patience under gentle manipulations, the invaginated bowel might have been reduced. I was, however, satisfied with my efforts, for there was every reason to think that the circulation had already been cut off, and that the opposing layers of congested peritoneum were hopelessly adherent. Moreover, the rapid fastening of a coil near the point of telescoping made it possible to get the child to bed alive; and, furthermore, it gave nature a chance for spontaneous sloughing and discharge of the invaginated coil. I expected fully that a natural cure would be effected by sloughing and discharge of the sphacelated small intestine. The possibility of a retrogression,—of a regurgitation, so to speak,—of the telescoped coil never occurred to me. The influence of distended coils of small intestine, forcing ahead in violent muscular paroxysms the intussusceptum, was apparently great—so great, indeed, that I would have regarded, as I did regard, mechanical reduction as impossible.

That the letting up of muscular spasm due to a temporary enterostomy, should permit a spontaneous disgorgement of the intussusceptum, seems an extraordinary occurrence, and one well worthy of being put on record. The lesson which I have learned in this and a few other cases, is that intussusception is a lesion about which we really know but little; that medical or palliative measures should be considered in the very beginning, and then only when the symptoms are mild and the patient's strength good; that surgical rather than medical treatment should be employed when the diagnosis is sure, after the failure of brief and gentle palliative measures; that a case must not be regarded as hopelessly involved because it has been of several days' duration; and finally that, because one case has become spontaneously reduced, we should not conclude that spontaneous reduction is likely, therefore frequently to occur.

And yet the experience gained in this case, in view of the results in every other case which I have seen, hardly justified departure from the usual methods advocated in the treatment of this formidable and fatal affection. The possibility of a spontaneous reduction, as Dr. Palfrey has shown by an extensive search through the literature, is so questionable that the case seems the only one in which disinvagination cannot be denied. Were the case to be taken as a justification for prolonged and forcible efforts at reduction by so-called medical treatment, much harm would surely result. The experience at the Massachusetts General Hospital has shown that only the most radical surgical operations are efficient—disinvagination by taxis, intestinal resections, enterostomies—and that even these measures have failed in most cases, because they have been the last rather than the first resort.

This case should lead us to assume that in all acute abdominal emergencies the gravest rather than the mildest danger threatens; that the most rather than the least effective methods should in the first instance be selected, even if there be greater danger in the application of the former. As the case herewith reported shows, the danger of the radical operation, with its attending complications—immediate and post-operative—exceeded necessarily in the long run the dangers which would have attended an immediate and effective

exploration. The best results and the lowest mortality in intussusception will follow those measures which, undertaken at the earliest possible moment, cannot fail to remedy completely and effectively the evil. (M. H. R.)

Of the few cases of true disinvagination that have been reported, a large proportion are far from conclusive. So infrequent and so uncertain are they that in a majority of the text-books of surgery, and also in many exhaustive articles upon intussusception, it is not stated that spontaneous disinvagination is possible.

Yet there is in literature a considerable mass of evidence that invaginated bowel may at times return to its normal condition without external assistance. Leichtenstern[1] thought it firmly established that intestinal invaginations may be reduced spontaneously; but, writing as he did (in 1876) before laparotomies were common, he cited cases in which the diagnosis was made on clinical evidence only. Treves in his work on intestinal obstruction (in 1884)[2] says, "There can be little doubt of the existence of this method of cure, although its occurrence must be of extreme rarity." He refers to two cases, reported in 1812 and in 1865 respectively, also to one more recent case, in which, after the clinical diagnosis of intussusception had been made, autopsies showed no abnormality, except that a portion of the intestine was shrunken and congested. In two other cases with symptoms suggesting intussusception, spontaneous recovery occurred without mention of discharge of slough; but in these, as Treves points out, simple fecal impaction cannot be excluded.

Fitz[3] in 1888, mentions the experiments of Senn[4] and the case of Langmaid[5]. Langmaid's case is as clearly defined as is possible from clinical evidence alone, but lacks the final confirmation of operation or autopsy. The experiments of Senn show conclusively, that artificial invagination in cats possesses a strong tendency to spontaneous reduction. Senn, however, has also expressed the opinion that infants and young children seldom if ever recover in this way.[6]

More recently a number of cases have been reported—all having considerable weight, but each establishing merely a strong presumption rather than absolute proof.

D'Arcy Power[7] reports a case in his service at St. Bartholomew's Hospital. The patient, a boy of six months, presented on entrance to the hospital, a typical picture of intussusception. Operation was performed at once—two and a half days after the onset of symptoms. No intussusception was found; but a portion of intestine three inches in length was intensely congested and covered with flakes of lymph. Above this area the intestine was constricted and the peritoneal covering abraded. From these findings and from his experience with the conditions present in intussusceptions, Power is confident that an intussusception had been present, and was spontaneously reduced. He mentions the case of Turner as the only similar one within his knowledge. This from such an authority upon intussusception as Powers, shows the rarity of spontaneous reductions.

Turner's patient[8] was a boy three and a half years old, who showed typical symptoms of intussusception, with a tumor in the right iliac fossa. At operation performed on the sixth day of illness no intussusception was found; but the lower three or four inches of the ileum were reddened, and the thin peritoneal coat roughened. Glands in the corresponding part of the mesentery were enlarged. After operation recovery was uninterrupted.

Underhill[9] reports a case in which the diagnosis of intussusception seems unquestionable. The tip of the intussusceptum could be plainly felt within the lumen of the rectum. The condition of the child was so bad that no operation was performed; yet the tumor gradually disappeared, and recovery followed. No evidences of sloughing or gangrene are mentioned.

Tuttle[10] describes a case in which the patient, when first seen, had pain, vomiting, bloody stools, and tumor. After transportation to the hospital and anæsthesia, no tumor could be felt. Recovery followed.

Johnson[11] reports a similar case in which the tumor was much smaller under anæsthesia than when first felt. At operation a small reducible intussusception was found.

Nothnagel[12] reports a remarkable case, which is much quoted by other authors. The patient, a man of fifty, in April, 1892, began to have attacks of pain and vomiting. The diagnosis was neoplasm of the intestine. Operation was advised, but refused. In June, 1892, after admission to the hospital, sudden and complete recovery occurred. In November, 1893, the original symptoms recurred; and, in addition, a tumor developed. In April, 1894, the abdomen was opened and there was found an intussusception, without adhesions and easily reducible. At the tip of the intussusceptum was a polyp. The inference is, that in the spring of 1892 also there had been an intussusception, ending by spontaneous disinvagination.

Meyer[13] reports a case of intussusception in a boy of nine and a half years. Laparotomy on the eighth day of symptoms revealed an extensive ileo-colic invagination. After efforts at manual reduction had failed, an ileostomy was performed as a palliative measure. From the time of operation, vomiting and pain ceased. Three days later gas and feces were passed by rectum. Three weeks after operation the fecal fistula was closed. The tumor disappeared, and the child recovered completely.

As has been said before, however, there is some weak point in the chain of argument in each of these cases. Even in the case of Meyer, the question may be raised whether gangrene and sloughing of the intussusceptum did not occur undiscovered. (F. W. P.)

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THE MANAGEMENT OF UTERINE FIBROIDS

By B. B. DAVIS, M. D., OMAHA, NEB.

IT is presumed that the profession is practically in accord in the management of myomatous tumors of the uterus, but there are a few moot points that may be profitably discussed. The past twenty-five years have seen so many modes of treatment brought to the fore, lauded, popularized, and then dropped, that a feeling of skepticism is abroad regarding the stability of any procedure. That the kaleidoscopic changes from medicine to electricity, oöphorectomy, hysterectomy, and myomectomy should have produced a feeling of uncertainty is pardonable.

To begin with, it will be taken for granted that every one has given up the Apostoli method. When such careful workers as Mackenrodt and Martin report that of thirty-six cases treated by this method sixteen were made distinctly worse, and three died, it must be conceded that it is much more dangerous than hysterectomy or myomectomy, besides being in the greater number of cases absolutely useless. The observations of many other careful men are in substantial accord, both as regards the dangers and the inutility of this procedure.

The so-called Tait or Hegar operation of removal of the ovaries to produce the artificial menopause and atrophy of the tumors has equally fallen into disrepute, and justly so. The atrocity of removing healthy ovaries with all the nervous and mental symptoms it entails, is enough to condemn this operation, even if it was efficient. But only a fraction of these tumors atrophy after the ovaries are removed, the growth of the larger proportion of them being accelerated. It is uncertain and unsurgical, and under the light of the present, unpardonable.

With these two procedures eliminated from consideration, it narrows the discussion to medical treatment and direct surgical attack (hysterectomy or myomectomy). If medical measures will accomplish anything, they should unquestionably be thoroughly tried before subjecting the patient to the surgeon's knife. Many drugs have been used. Startling claims of their efficiency have repeatedly been made. Others have been encouraged to give them a trial, and have met with disappointment. Mention of a few of the remedies most lauded would include ergot, hydrastis, chloride of calcium, iodine, iodide and bromide of potassium. gallic acid, salts of mercury, thyroid extract, and many more.

The drug which heads the list in popular favor, and probably in usefulness, is ergot. A glance at the effects claimed for it is of interest. It is thought to check the growth of the myoma by contracting the vessels which feed it. Its greatest advantage has been considered by some to be due to stimulation of the uterine muscle fibres, thus extruding the tumor from the uterine wall, either towards the cavity or towards the peritoneal surface. One of the few things I remember of my medical lectures while in college, is the most realistic picture drawn by the professor of gynæcology, showing how with each uterine contraction produced by the ergot, the tumor approached nearer the mucous membrane, next it began to project into the cavity, became pedunculated, the pedicle became narrower and longer, the tumor was extruded into the vagina, when an accoucheur came along, and by a clever twist of the pedicle, the woman's sufferings were over. I wonder how many believe this now? This mode of relief of a submucous fibroid does frequently occur—quite as often, no doubt, when no ergot is administered as when it is given to the limit. Think, too, for a moment of the risks of the procedure, if ergot could do what was claimed for it! The risk of death from hemorrhage is great. Sloughing and sepsis are dangers that have cost many lives. If a patient of mine had an interstitial myoma, I would prefer that it remain interstitial rather than run the risks of its removal by the method which ergot was formerly supposed to effect.

Those who were formerly most favorable towards the use of ergot admitted that in order to produce any effect, it has to be used for a long period, that it impairs digestion, interferes with

cardiac action, deteriorates the general health, and produces mental depression. As soon as its administration is stopped, early relapse into the former condition occurs. Thus these patients were little, if at all, benefitted by the treatment. As Bishop puts it: "It would seem that the small good, if any, to be obtained from this drug is being purchased at an absurdly high rate; that, indeed, it is overwhelmed entirely by the definite harm done."

Let me quote from Meadows, who was writing from a medical standpoint: "I am firmly convinced that to persuade women for months and years to swallow gallons of medicine, mostly of a depressing and debilitating kind, in the *vain* hope that we can thereby bring about the absorption and removal of a hard fibroid tumor, is not only unscientific, but unreal and dishonest." He further says: "I believe that drugs are utterly inert in promoting the removal of uterine fibroids."

Let me quote a few others, mostly expressions of opinion made before the modern surgical methods came into vogue, and showing the utter discouragement on the part of the profession: "The uselessness of all medical treatment is a thing admitted" (Steavenson); "There is no medicine which acts immediately upon fibroid tumors so as to cause disintegration and absorption" (Hart and Barbour); "All medicinal treatment is absolutely useless" (Boldt); "No drug has been discovered that has any influence upon the growth of a fibroid tumor" (Penrose); "Medical treatment is a myth" (Tait).

Judging from such expressions as these, and from every-day experiences of all, it is necessary to look for something besides drugs if one would find any effective treatment for uterine fibroids. Mental and physical repose will do much to prevent or ward off disagreeable symptoms in a certain class of cases, but many must be handled promptly and in a heroic manner if any good is to be accomplished.

The logical treatment of any tumor is its complete removal. This had been the feeling for many years, but unfortunately the surgical removal of fibroids was followed by such a frightful mortality that no one felt justified in advising it. In 1878 Spencer Wells published his first 24 cases of hysterectomy; 15 died from three hours to fourteen days after the operation, a mortality of 62.5 per cent. Such a mortality is prohibitory. Even as late as 1887 Keith put the mortality at 25 per cent, but stated that it was probably much higher, and expressed the opinion that hysterectomy had done more harm than good.

It is unnecessary to trace step by step the evolution of the operative treatment of fibroids from the early beginnings with a mortality so high that even the most rash hesitated to advise it to the very low death rate of the present. The extra-peritoneal method of treating the stump gradually gave way to the sub-peritoneal. Panhysterectomy had its innings, and is still done largely in England, I am informed. Now, the technic has become almost routine to save one or both ovaries, remove the body of the uterus, and retain the cervix, covering it over with peritoneal flaps in such a way as to leave a smooth pelvis with no raw surfaces to invite adhesions.

The wisdom of retaining the cervix is apparent when it is realized in how much more normal relationship the rectum, the bladder, and the vagina are left than when it is taken away. Without the cervix the vagina becomes shortened, and often a very troublesome prolapse of the vaginal walls occurs.

Besides this, the total removal of the uterus is a much more formidable operation from the standpoint of difficulty and time required than is supra-vaginal amputation. In pan-hysterectomy the risk of wounding the bladder or cutting the ureters, as well as the danger of an infection from below, are greatly increased.

In very exceptional cases a fibroid grows so low down on the cervix that total hysterectomy becomes necessary.

One other procedure is frequently advisable. When the location of the fibroids permits it without too much danger, the tumors may be enucleated from their beds, the cavities filled by layer sutures and the uterus retained. This is especially a method to be used where practicable among those patients who are childless and still at the child-bearing age. A good many cases have been reported where pregnancy has followed this operation, when the woman had been married for many years without ever before having become pregnant.

Some caution must be observed in selecting cases for enucleation. It must be understood that the dangers of post-operative hemorrhage are greater than after hysterectomy unless great pains is taken to secure absolute hemostasis. It is also of the greatest moment that no small fibroids be left, as they are likely to grow rapidly after removing the larger ones, and necessitate another operation in the near future, and thus mar the luster of an otherwise successful operation. This accident happened to me in my first case, and since then I have been exceedingly careful to examine every part of the uterus in my search for small intra-mural growths.

There is still another type of case—the submucous variety—which can often be removed from below without removal of the uterus. This, of course, applies to those cases where no intra-mural or sub-peritoneal fibroids exist.

I have not recommended vaginal hysterectomy for fibroids for the following reasons: (1) it necessitates the removal of the cervix, and it has been shown that retention of this portion is of great advantage; (2) it is impossible to practice satisfactorily the conservative method of enucleation by this route, and in many cases the choice of enucleation or supra-vaginal amputation is left until the abdomen is opened; (3) the conservation of one or both ovaries is much more intelligently carried out through an abdominal incision; and (4) if the tumor is very large, removal by the vaginal route is impracticable.

The question what advice to give to a patient afflicted with uterine myomata is dependent on a variety of conditions. There are certain conditions which are to be considered positive indications for immediate operation:

1. Rapid growth of the tumor or tumors.
2. Very profuse menstruation or irregular hemorrhages.
3. Sufficient size of the mass to make its retention a burden.
4. Pain of great enough intensity to interfere with sleep, or to necessitate the use of analgesics.
5. Impaction of a tumor in the pelvis.
6. Urinary symptoms from pressure on the bladder, or obstruction of the ureter, causing hydro-nephrosis.
7. Sufficient pressure on the rectum to interfere seriously with defecation.
8. Infection of the tumors or pyosalpinx.
9. Purulent discharge from the uterus.
10. Finally if the patient's mind is so disturbed by the knowledge of the presence of the tumor that her life is rendered a burden, this should be considered a positive indication for operation.

On the other hand, if the tumor is small, not growing rapidly, and producing no disturbance, the problem becomes much more complex. Many such growths remain till old age, and never cause the patient any discomfort. A proportion of them atrophy after the menopause, and occasionally they have been known to atrophy during menstrual life. What considerations should influence one's advice for or against operation?

If the patient is married and childless, what prospect is there of her bearing a child in her present condition? If pregnancy occurs, will the conditions permit full term to be reached, and the safe delivery of a live child? or will the tumor or tumors necessitate cæsarean section? If any considerable tumor grows low down on the cervix, or in the broad ligament, or is adherent in Douglas cul-de-sac, the prospect for normal delivery will be remote. If situated well up towards the fundus, labor will not be likely to be interfered with. Occasionally, perhaps, when the desire for children is very great, or under very exceptional circumstances, when the bearing of a living child is of preëminent importance, even when normal delivery is deemed impossible, one might be justified in allowing pregnancy to take place, and gestation go on to maturity, and cæsarean section be done.

While on this subject it is well to bear in mind that when fibroids are present, pregnancy is very apt to be interrupted by abortions and miscarriages, due to mechanical causes. That in these cases great difficulty is sometimes experienced in getting rid of the fœtus and membranes because of these same mechanical causes, and that infection is much more likely to occur under such conditions than when the uterus is normal. When infection occurs, it is more serious when fibroids exist, the tumors often suppurating and sloughing, life being greatly endangered.

There is still another phase which ought sometimes to influence one's advice where the subject of child-bearing is of importance. The woman may have been married many years

and never pregnant. The presence of the fibroids is the probable cause of her sterility. Is there a possibility of the tumors being enucleated and the uterus retained, and pregnancy rendered possible? As already stated, a number of cases have been reported where women, after many years of unfruitful married life, have conceived after enucleating the fibroids.

Another consideration influencing the advice to be given is to be found in the answer to the question, "Even if the fibroid seems innocuous now, what assurance have we that it will not suddenly begin to grow rapidly, or to cause excessive hemorrhage, or produce any one of the many distressing complications which frequently occur?" If it is decided to adopt the let-alone treatment, it ought to be distinctly stated that some untoward conditions may arise necessitating operation, and the patient urged that in the event of any serious symptoms occurring, she should hold herself in readiness for immediate surgical intervention.

The proneness of myomata to malignant transformation, judging from my own experience, is much greater than one would suppose from a perusal of our text-books. I have met a number of instances where fibroids had been known to exist for many years, not growing much, causing no especial inconvenience. Suddenly they have begun to grow rapidly, become painful, severe hemorrhages occurring, and when operation was undertaken, inoperable sarcoma has been found. This has made me feel that in advising a waiting policy one is assuming a very grave responsibility. It has even occured to me that the responsibility is too great for any one to be justified in carrying. It is my firm conviction that in every case the risks of the malignant change should be plainly stated to the patient or her husband, and that they have the onus of deciding whether they wish to risk the chance of the advent of sarcoma or not. This puts the responsibility where it justly belongs, and a patient has a right to know facts of this nature. If such knowledge is withheld, and the malignant change occurs, there is very just cause for complaint.

The risks of delay in operating for fibroids are so many, and the penalty when severe complications arise is often so heavy, that there is only one class of cases where I feel justified in definitely advising against operation. If I find a fibroid causing no untoward symptoms in a woman nearing the menopause, or past it, and am positively convinced that the tumor is distinctly atrophying, this I would consider a definite indication for non-interference.

The suggestion made may seem too radical, but I have seen so many women almost in extremis from the practice of too strenuous dilatory tactics, that I feel as if the existence of fibroids has been considered of less importance than the facts warrant, and that perhaps we have sometimes failed to appreciate the many perils that beset the paths of the numerous women thus afflicted.

EDITORIALS

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THE PRESENT STATUS OF THE RADICAL OPERATION FOR CANCER OF THE CERVIX UTERI.

The development of the radical operation for carcinoma cervicis uteri appears to have reached a critical stage. At the convention of the American Gynæcological Society in May of this year the radical abdominal operation, as proposed by me, seemed to have very few friends. If the opinions expressed there were to influence the gynæcologists of the world, we should soon find ourselves at the same desolate standpoint from which we started ten years ago. Happily, a truly astounding contrast exists between the opinions promulgated at the meeting of the American Gynæcological Society and the researches published some two weeks later at the meeting of the German Gynæcological Society. On closer inspection this contrast becomes even more surprising as it is seen that the essayists of the American meeting based their calculations almost exclusively on the statistics resulting from the work of the very same German investigators and operators who drew therefrom the opposite conclusions, and who were practically unanimous in favor of the radical method with removal of glands. As, therefore, the American meeting offered no new facts, it is to be hoped that the expression of opinions alone will not materially disturb the progress of the actual work.

Thanks to the heroic industry of gynæcologists of various countries, the investigation of carcinoma of the cervix uteri has made most brilliant progress in the last decade. This research has proven conclusively that our old ideas of the pathology of this disease were erroneous in so far as they assumed that the advance and spreading of carcinoma of the cervix was different from that of other cancers.

We know now that carcinoma of the cervix, like other carcinomas, is liable to invade early not only the connective tissue surrounding the primary seat of the cancer, but the regionary lymph glands. We know further that nothing short of microscopic examination of complete series of sections can determine whether connective tissue and glands are invaded or not. We know that enlarged glands may be free from carcinoma and small ones may contain carcinoma. We know that palpably infiltrated ligaments may be free from carcinoma and that soft ligaments may contain carcinoma. We know that the size of the primary carcinoma is no reliable criterion of the lymphatic invasion, and that this invasion usually follows certain paths. In other words, and to be very brief, we know that carcinoma of the cervix behaves exactly like other cancers, and presents the same laws and the same lawlessness.

What, therefore, should appear more reasonable and desirable than to submit carcinoma of the cervix to the same treatment which is generally and unqualifiedly accepted as the only scientific and safe one in cancer of other regions of the body?

If this operation were neither more difficult nor more dangerous than that for cancer of the breast, for instance, the objections to it would probably be noticeably fewer and less violent. But the operation, as built up on these pathological data, is undoubtedly a formidable one. To carry it out, as I had proposed it in 1895, means a radical departure from popular gynæcological methods of tying and suturing ligaments and forming pedicles. The operation means a thorough anatomical dissection. It must include, not a search for glands, as has so often been stated erroneously, but a dissection. This operation is of necessity a tedious and dangerous one, and, as for instance, represented by Wertheim's first series, where he followed my method closely, the result is a high primary mortality. In addition thereto, many advanced cases were operated on in spite of my warning against useless attempts on inoperable cases. Modifications of the method, therefore, were considered necessary.

Mackenrodt's transverse incision of the abdominal wall with formation of a peritoneal apron, Ammann's efforts towards better protection of the ureters, and others, were in this line.

But the improvement in the mortality rate, of which some operators are so proud of late, has quite a different reason. The name of "radical abdominal operation" has largely been misappropriated. It is exceptional, extremely exceptional, at present to see an operator do a thorough dissection of the pelvis in the so-called radical operation. What most of them term "radical abdominal operation" is nothing but the old Freund abdominal operation plus dissection of the ureter and a digging out of a few glands. I have had occasion to observe this myself, and Latzko has made the same statement at the German Gynæcological convention this year.

There are several important consequences of this reduction of the radical operation:

1. The percentage of glands found cancerous appears smaller, because fewer glands are removed, and the false conclusion of the rarity of cancerous glands gets a new start.

2. The time of operation is very much shortened, and we hear of "radical" operations done in forty minutes.

3. The operative mortality sinks, and

4. Very naturally, the recurrences pile up just as before the radical operation was invented.

This is why I speak of a critical stage in the development of the cancer operation. While radicalism, mitigated and tamed, is rewarded by a low operative mortality, ultimate failure of the whole work is invited.

What is the use of talking of igniextirpation per vaginam when the father of the method has abandoned it in favor of the abdominal work? What is the use of denying the importance of the glands, when two-thirds, or even only one-third of the cases are sure to have cancerous glands, which are left behind in the most perfect vaginal work, and are liable, and known, to show up as glandular recurrences afterwards? What is the use of removing only enlarged and not small or soft glands, when we know that there are no reliable criteria before removal?

Our duty towards the carcinomatous patient must be to attain the greatest possible protection from the return of the disease rather than to minimize the interference. I am encouraged to believe that the road which I have pointed leads in this direction. My seven cases who have survived the operation are still free from recurrence, the oldest one having

been operated on over nine years ago. Every step back from the minimum requirements, which I have stated ten years ago, may be expected to increase the ratio of recurrences. Every improvement in operative technic, or asepsis, which is apt to reduce the operative mortality ought to be eagerly welcomed.

EMIL RIES, M.D.

FROZEN SECTIONS AT THE TIME OF OPERATION

It is well recognized that benign and malignant neoplasms, which are deep-seated or subcutaneous, present so many symptoms and signs in common, that a differential clinical diagnosis is almost impossible without the aid of the microscope.

A careful review of the clinical histories of neoplasms elicits the fact that the length of time a tumor has existed counts for little in forming an opinion as to its malignancy. The appearance of the gross specimens is often misleading, and mistakes are made by the most experienced surgeons.

If, after exhausting all clinical methods, including macroscopic examination, a positive diagnosis cannot be made, then a microscopic examination of a section must be had before deciding on the extent of the tissues to be removed. To excise a section of a neoplasm for examination is not entirely free from danger, particularly in that class of sarcomas in which the blood-vessel walls are made up of tumor cells, since metastasis can readily occur, therefore, a section for examination should rarely be removed previous to the operation. The desired end can be attained with the microscope as an aid, by freezing an excised portion at the time of operation. This can be accomplished with ease and dispatch, the time required being so short as not to militate against the patient's chances of recovery.

With this most valuable adjunct at hand its use should be taken advantage of in all cases where the question of the possibility of malignancy exists.

The laboratory of every well-regulated hospital should be equipped with the apparatus necessary for making a frozen section. A carbonic acid gas cylinder is about all that is required, and this can be easily secured.

While an examination of a frozen section may not be quite as satisfactory as one made from hardened tissue, because of its thickness, it usually enables one to make a positive diagnosis. In every case of a neoplasm, in which the diagnosis is at all doubtful, the surgeon should safeguard the interests of his patient by making a frozen section at the time of operation, and have the diagnosis made positive by microscopic examination.

SUBPHRENIC ABSCESS IN CHILDREN

Subphrenic abscess is not commonly met with in practice and in adults the diagnosis is usually difficult. When seated posteriorly these abscesses have a tendency to burrow upward and frequently simulate a purulent pleural collection, and if gas is present, they may be mistaken for pneumothorax. In children the same errors are committed and according to Maydl subphrenic abscess was met with in children only ten times out of a total of 179 cases. But more recent statistics show that the relationship of this affection between children and adults is as high as twelve cases out of sixty-eight.

The causes for this affection are numerous. Jopson (*Arch. of Ped.*, 1904) insists on the importance of gastric affections, such as gastric or duodenal ulcer, as a starting-point. On the other hand, appendicitis is an important etiological element, and the same may be said of infections of the liver. The inflammatory process has originated in a few cases from a perinephritic abscess. Out of ten

cases Maydl found that traumatism was incriminated in three, while in two others the affection started from a cholecystitis. In another instance the abscess followed a perforation of a gastric ulcer, and still another from an appendicitis. In more recent statistics we find that out of twelve cases, six times appendicitis was the cause, gastric ulcer twice, vertebral caries, traumatism, and suppurating cholecystitis each once. It is evident that appendicitis is the predominating etiological factor, the cause being rarely supradiaphragmatic, according to Maydl, nine times out of a hundred and seventy-nine cases.

The symptoms of this affection vary according to whether the abscess burrows forward or backward; the latter is more frequent, however. The child slowly loses flesh, and complains of a vague pain localized at the base of the thorax, or at the upper part of the abdomen. Upon examination the right side of the thorax will show some amplication posteriorly at the base, and by comparing the two sides, this will at once become evident. The region is dull on percussion, and respiratory sounds are absent. One immediately thinks of pleurisy, but the upper line of dullness is not as distinct as in the latter disease. On the other hand, one does not detect the pleuretic souffle in subphrenic abscess, and during deep inspiration the pulmonary sounds are not heard below the line of dullness.

An exploratory puncture will show the presence of pus, but in order to reach it, the needle must be thrust in deeply. When inserted, the needle will be drawn downward at each inspiration, the change in direction being due to contraction of the diaphragm. This sign, which is extremely important for the diagnosis, was first pointed out by Furbringer, while Pfuhl's sign consists in a rhythmical flow of pus through the trocar with each inspiration. Theoretically, it also allows one to localize the subphrenic collection, but in practice its value in this respect is rather doubtful. These abscesses are never punctured with needles of sufficiently large caliber to allow one to observe this discharge of fluid without aspiration. In other cases the diagnosis will remain uncertain until operation.

It is only during surgical intervention that the surgeon's finger, inserted in the wound, detects the diaphragmatic opening, and thus decides the subphrenic localization of the collection.

The treatment is strictly surgical, and very few cases get well spontaneously, and this only after the abscess has opened into one of the anatomical cavities which surround it. Cure after spontaneous rupture is also rarely met with. Watson advises incising the abscess after resection of about two centimeters of the fifth rib, and in one of his cases the patient was discharged well at the end of a fortnight. Bosanquet, in 1898, and Comby, in 1904, have reported a series of cases where surgical treatment was most successful. Nevertheless, all these cases do not recover by operation, and out of a total of seventy-four instances, Maydl found a mortality of 47.2%.

Certain abscesses are especially serious, more particularly those which follow a perforation of the stomach or intestines. Out of twelve cases recorded by Jopson, ten were operated on with eight recoveries, while in the remaining two, the patients evacuated the pus spontaneously through the trachea. More recent statistics show a mortality of 13% in operative cases, and 75% in those where no operation was undertaken, consequently these figures speak eloquently in favor of surgical interference.

CHARLES GREENE CUMSTON.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF SURGERY

UNDER THE CHARGE OF

JOHN B. MURPHY, M. D. — E. WYLLYS ANDREWS, M. D
FREDERIC A. BESLEY, M. D. — WM. R. CUBBINS, M. D

FINAL RESULTS IN THE X-RAY TREATMENT OF CANCER, INCLUDING SARCOMA. By William B. Coley, M.D., New York. (*Annals of Surgery*, August, 1905.)

In this article the essayist makes a very careful analysis of the cases he has observed since 1902. The number of cases under observation and treatment was one hundred and seventy-six, and of these one hundred and sixty-seven were malignant tumors.

The list comprised the following: 68 cases of sarcoma, 36 cases of carcinoma of the breast, 44 of epithelioma of head, face, and neck, including tongue; 14 of deep-seated abdominal growths, probably carcinoma, 5 not classified, 3 of tuberculosis of glands of the neck, 3 of Hodgkin's disease, 3 of lupus.

He states that in 5 of the 68 cases of sarcoma, complete disappearance was observed, but in every one of these cases there was a recurrence within a few months. Toxins were also used in the treatment of these cases. Brief histories of these cases are given. In 4 cases of carcinoma of the breast, the X-ray was used as a prophylactic immediately after operation, and in each case recurrence took place within a few months. In the author's entire experience with the X-ray, only one case of a deep-seated carcinoma disappeared. Mikulicz's results are quoted, and also show that the influence of the X-ray upon other than carcinoma of the skin is very slight. Vose and Howe are quoted, their report being based on 120 cases treated by X-ray. They do not report a single case of deep-seated carcinoma or sarcoma as having disappeared under treatment.

The plan of pre-operative treatment by the X-ray, even in small cancer, as advocated by Dr. Morton, is condemned as pernicious and fraught with grave peril to the patient. He contends that the breaking down of the tumor tissue, which occurs before absorption takes place, entails the risk of some living cells getting into the circulation and leading to generalization of the disease.

The experiments upon mice, as carried on by Drs. Park, Gaylord, and Clowes, substantiate this opinion. Finally, these very rational conclusions are drawn:

The results of the X-ray treatment of malignant tumors, up to the present time, have proven:

1. That the X-ray exerts a powerful influence upon cancer cells of all varieties, but most marked in cases of cutaneous cancer.

2. In some cases, chiefly in superficial epithelioma, the entire tumor may disappear, probably by reason of fatty degeneration of the tumor cells with subsequent absorption.

3. In a much smaller number of cases of deep-seated tumors, chiefly cancer of the breast and glandular sarcoma, tumors have disappeared under prolonged X-ray treatment. In nearly every one of these cases, however, that has been traced to final results, there has been a local or general return of the disease within a few months to two years.

4. In view of this practically constant tendency to early recurrence, furthermore, in the absence of any reported cases well beyond three years, the method should never be used except in inoperable cases, or as a prophylactic after operation, as a possible, though not yet proven, means of avoiding recurrence.

5. The use of the X-ray as a pre-operative measure in other than cutaneous cancer is contradicted, (1) because that the agent has not yet been proven to be a curative; (2) because of serious risks of an extension of the disease to inaccessible glands or to other regions by metastases during the period required for a trial of the X-ray.

COMPLETE TRANSVERSE TEAR OF THE PANCREAS HEALED BY SUTURING. By C. Garre. (*Beiträge zur Klinischen Chirurgie*, June, 1905, Bd. 46, Heft 1.)

Because of its concealed position in the abdomen, the pancreas is seldom affected by injury, and the most of such traumas are complicated by

tearing or perforation of neighboring organs—the reason for the usual lethal outcome of such injuries. Even the very rare, isolated wounds of the pancreas have, at the outset, an unfavorable prognosis because of severe hemorrhages, and the more dreaded action of the pancreatic juice upon the peritoneal fat tissue.

Professor Garre reports, from his clinic in Königsberg, a case of total transverse, subcutaneous tear of the pancreas only, which by operation led to healing. The patient had been crushed in the upper abdominal region between two car bumpers. There was some little pain after the accident, no vomiting, or nausea, no shock, and pulse and temperature were normal. The abdomen was tense, and there was some tenderness in the epigastrium. Three hours after the injury, vomiting of coffee ground material and some blood set in, with severe pains. The diagnosis of rupture of an intestine was made, and an immediate laparotomy followed. Considerable hemorrhage was found in the abdomen, and after an examination of the other organs in the peritoneal cavity had shown them to be intact, the blood was discovered coming from behind the stomach, which was somewhat low in the abdomen, but uninjured. Tearing through the lesser omentum, above the stomach, they came upon the tear in the pancreas, the end edges of which were about the thickness of a thumb apart. The edges were sharp, as if cut with a knife. The splenic vein was intact. The severed tail of the pancreas was about 10 cm. long.

The torn edges of the organ were brought together, and with three posterior and three anterior fine silk sutures through capule and parenchyma the defect was repaired, and the hemorrhage stopped. The sutured portion was isolated by tampons, gauze was put around the pancreas, wound, and up under the liver, and was brought out of the original incision. There were no areas of fat necrosis.

The progress of the case was most pleasing. The pains ceased at once. For two days there was bloody vomitus. On the third day the tampons were saturated with pancreas secretion, and in the subcutaneous fat layer there were three fat necroses. The secretion was examined, and showed all the pancreatic enzymes. The first tampon was removed after eight days and a new, loose one inserted. In two weeks a drain was put in. The secretion became less and less, and in two weeks more the drain was omitted. In about six weeks the fistula was closed.

The diagnosis of a subcutaneous pancreas rupture has not yet been established. One factor to which Korte refers is worthy of consideration. In the first hours after the injury there are, as in this case, no remarkable phenomena, little pain, pulse normal and regular, no shock, and no vomiting. Only after some time, a few hours to two days, severe colicky pains come on with vomiting that remind one of acute pancreatitis. Sometimes these symptoms are not noted. When other organs are injured, and when there is laceration of the pancreas with open wounds, complicating symptoms enter. Among the thirty subcutaneous injuries of the pancreas which the author has collected from literature, there are only eight isolated and uncomplicated cases, and the one he reports is the ninth, and the only one that was treated surgically. With so few cases one cannot, from the limited number of observations, establish a well-defined disease picture.

Garre reviews these eight cases. The tear of the pancreas resulted from kicks, from being run over, from falling against a wagon wheel, from being caught between two car bumpers, from a blow from the pole of a wagon, and from an injury from a flywheel. All of these patients died.

The author emphasizes the importance of looking for the splenic artery in such cases, for, if it is torn, the tail of the pancreas would not then be nourished, and should be extirpated to avoid a necrosis. The closure of the abdomen after the sewing of the pancreas must be avoided, because of the deleterious effect of the pancreas secretion. V. Mikulicz has emphasized this danger. He estimates the mortality of those cases which are tamponaded at 30%, and those which are not, at 80%.

RESECTION OF CHEST WALL FOR MALIGNANT GROWTHS.* By Dr. Rixford, San Francisco.

On the basis of six more or less extensive resections of the chest wall for malignant tumors, one for sarcoma, five for recurrent carcinoma of the breast, Dr. Rixford discussed the indications for resection of the chest wall in such cases, and the technic to be employed. He said that in many cases of recurrence after radical removal of the cancerous breast, the recurrence was local when discovered, and could be successfully removed. After the modern radical operation, which we know by the name of Halsted, recurrence, even in the skin, is pretty certain to invade the chest wall, because the subcutaneous tissues are so thoroughly removed, and the skin, therefore, lies in such close proximity to the ribs. A frequent site for recurrence, involving the chest wall, is at the edge of the sternum, where the lymphatics pass to reach the mediastinum. The infection is stopped for a

*Read at meeting of American Surgical Association, San Francisco.

time in the mediastinal glands, which lie immediately beneath, much as extension is limited in the axilla. May not such metastases be removed, as is so successfully done in the axilla? In point of technic the ordinary resection of the chest wall, when unilateral, does not require the use of any apparatus for artificial respiration when the patient is in good enough condition otherwise to warrant operation. The acute pneumothorax, in the six operations, gave rise to no serious symptoms, although the respiratory efforts were, of course, greatly increased as long as the chest was open. The rather violent flopping of the heart from side to side, and the fatiguing efforts at respiration, were greatly diminished by mechanical closure of the opening in the chest wall with the hand of an assistant, or a wet towel, closure being made at the moment of complete expiration. The wounds were closed by means of large skin flaps, lifted up generally from the anterior abdominal wall. The amount of air left in the chest after closure of the wound was greatly lessened by letting the air out by means of a pair of forceps introduced between sutures and withdrawn at the moment of complete expiration. Though the air in an acute pneumothorax is rapidly absorbed, it was argued that by diminishing the quantity in the beginning the patient can breathe with much less effort, and hence with less pain. After the operations, the patients continued to breathe rapidly for about a week, even after percussion failed to demonstrate air in the pleural cavity, but this is probably due to soreness incident to movement of the chest wall rather than to diminished respiratory capacity.

In the six operations there was no mortality. One patient was operated upon twice, one patient died of pulmonary carcinoma four months after operation; one is living, twenty months after the resection, but has small recurrence in the mediastinum; one, operated upon twice, shows now no recurrence, eleven months after first resection; one is free from recurrence two years after resection (case of Dr. Stillman). The case of sarcoma of the clavicle in a man of seventy required removal of two-thirds of the clavicle, the whole of the first rib internal to the vessels, and the upper two inches of the sternum. The patient is free from recurrence, and is in vigorous health, eleven months after operation.

UPON THE FORMATION OF DIVERTICULA IN APPENDICITIS. By Max V. Brunn. (*Beiträge zur Klinischen Chirurgie*, Bd. 46, Heft 1, 1905.)

In an article a year ago, V. Brunn indicated the severe damage done to the muscularis of the appendix in appendicitis. There is always, in acute stages, a marked small cell infiltration, and there may form small abscesses, which, by breaking to the serosa or submucosa, prepare for a perforation.

When such a break heals, the various layers become again more or less intact, the mucosa only in a rudimentary form. The space in the muscle coat is usually bridged by connective tissue, which is also the case where there is only a very severe acute infiltration of the muscle sheaths. From such a remaining sclerosis, especially in the inner coat, one can, at a later time, draw conclusions as to a preceding inflammatory process.

From his histologic study of appendices removed after the cessation of the acute symptoms, V. Brunn has met with many diverticula, which have their origin in severe inflammation of the muscularis, or in healed perforations. These were not true diverticula, with protrusion of all the layers of the organ, but false ones, the outer boundaries of which were formed of scar tissue, while the inner surfaces were covered with more or less perfect mucous membrane. His technic was to fix his tissues in ten per cent formalin, embed cross, and occasionally longitudinal, sections in celloidin, and stain by Van Gieson's method. He gives complete histo-pathologic findings, illustrated by sketches, and reviews the clinical features of eight cases. All of these had previous attacks, varying in number from two to many recurring ones. There were also different numbers of diverticula on the several appendices, some showed only one and some had three. When these abnormal structures were examined, it was evident that a similar process took place in all. In every instance there was a break in the muscular wall of the appendix, which was replaced incompletely by distensible scar tissue. At these locations the coat of the mucous membrane was effected in various ways by protrusion, by invagination, or by change of position. In two cases there were simple conditions which will be reviewed here. The first glance at the stained section gave the impression of a widened, eccentrically placed lumen, and on analysis there was invagination of the mucous membrane. There were many minor variations, however. The diverticulum may be separated from the lumen for some distance, and communicate with it only in a small area. The protrusion may also be much larger than the lumen of the organ. In one instance there were two diverticula, which, at one and the same level, opened into the cavity of the appendix, and into each other, but for the greater distance were entirely distinct. At one location these diverticula lay entirely outside of the complete muscle ring. Sometimes the opening between the lumen and the diverticulum was no longer to be demonstrated,

and the accessory space was seen occasionally to open outward, a condition which was probably produced by the manipulations at the operation. This latter finding gave a clew to the explanation of one peculiar pathologic structure, which looked, microscopically, much like a simple perforation, but, as there were vestiges of mucous membrane on the neighboring adhesions, there could be no doubt that this picture was also one of a diverticulum, the outer side of which had been lost in greater part at the laparotomy. In some areas the original mucosa was forced against the opposite covering, and entirely pressed away.

Concerning the production of these diverticula, the conclusion seems justified that they arose from an inflammatory basis, and that a perforating appendicitis preceded all of them.

The muscle scar was absolute proof of the former destruction of the muscle tissue. Normally, where the blood-vessels enter the appendix, the muscularis is broken by connective tissue, but the physiologic interruption could be differentiated from the pathologic one by the fact that the latter does not serve as a portal for such a vessel, and also by the surrounding sclerotic tissue. The character of the mucosa was also changed in these diseased structures. In place of the normal cylindrical epithelium, which sinks down to deep, regularly arranged gland tubules, there were, in the diverticula, only layers of low cuboidal cells. Glands were usually absent, but if some were found they were atypical. Exceptions did occur, for in one diverticulum of undoubted inflammatory origin, there were in places well-formed mucous membrane. The conduct of this mucosa could not be explained by simple stretching, and it was not probable, therefore, that the majority of the diverticula arose by the pushing of the mucous membrane into the break in the muscularis. On the contrary, the covering of the diverticulum, with its manifold differentiation, speaks for a regeneration of the mucosa, and its ulcerations and granulations indicate inflammation.

The mechanism of the formation of these diverticula was, therefore, according to V. Brunn, as follows: an inflammation of the appendix leads to the perforation of the whole, or a large part of it, after peritoneal adhesions have formed. There arises then an abscess, which communicated with the interior of the appendix. If the process goes on to healing, and if the neighboring epithelium is able to reproduce, this begins to repair the defect on the one hand as the connective tissue does on the other. The result of the regeneration will depend, in part, upon the size of the defect and of the abscess. If the damage is slight there will be no diverticulum, and if it is large the formation of such a structure will be favored.

The conduct of the mucous membrane in perforation is of prime importance in understanding healing processes. If it is destroyed for some distance around the perforation, all possibility of a diverticulum will be removed, and an obliteration of the lumen will follow. Often in perforations the mucosa can be found spreading over the wounding in the musculature, showing the ease with which on healing a diverticulum may form. A third possibility is where mucous membrane remains partly intact and the remaining layers more or less necrotic. If, then, there occurs an accumulation of inflammatory exudate in the lumen, with corresponding increase of pressure, part of the mucosa should be forced through the defect, and, in favorable cases, should develop farther. Finally, it may occur that only the musculature may be destroyed by a circumscribed abscess, and the healthy mucous membrane forced against and into it. The author cites additional cases to illustrate some of these points and special points of some cases in which there was only a simulation of diverticulum, due to a simple knuckling of the appendix. A somewhat extensive literature is analyzed.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF GYNECOLOGY

UNDER THE CHARGE OF

J. CLARENCE WEBSTER, M. D. E. C. DUDLEY, M. D.
JOHN C. HOLLISTER, M. D.

LE SARCOME DE L'UTÉRUS. ÉTIOLOGIE—ANATOMIE PATHOLOGIQUE DU SARCOME DU CORPS. Par G. Piquand. (*Rev. de Gyn Mai-Juin, '95*)

A historical review of the literature on Sarcoma of the uterus is given first. Some thirty-seven authors are quoted from Joly in 1766 to LeDentu in 1904. A complete list of references is given.

Etiology. "Sarcoma of the uterus is rare—we have found a total of 416 cases only in all literature. The frequency is difficult to establish, even approximately." The percentages of several authors are given which vary widely.

"0.076 per 100" of those coming to the gynecological clinic at Berlin.

"0.47 per 100" at Wurtzburg.

Proportion of sarcoma to cancer:

"1 to 50" at Breslau.

"1 to 47" Krukenburg.

"1 to 24" Poschmann, etc.

"Exact etiology absolutely unknown." Cohnheim's theory is discussed. "It is a less satisfactory theory for tumors of the uterus than for tumors of the urinary apparatus."

Predisposing causes:

1. Neoplastic heredity.
2. Presence of other uterine tumors.
3. Traumatisms and inflammations.
4. Sterility.
5. Age of patient.

Neoplastic heredity.—Cases not numerous; histories apt to be unreliable.

Presence of other tumors.—Presence of a tumor in anterior part of uterus, i. e., fibroma, has been considered as predisposing cause. Probably a coincidence. On the contrary, fibromas are susceptible to sarcomatous degeneration.

Several cases have been reported where the uterine involvement was apparently secondary to sarcoma of other organs; i. e., ovary, breast, lung, etc.

Traumatisms and inflammations of uterus, and especially deviations and obstetrical traumatisms, have been considered as predisposing causes, but such is not borne out by the facts.

Sterility.—"In our 416 cases 90 were in sterile women." "We do not believe that Terrillon exaggerated the importance of sterility." Also he does not think "secondary sterility" more important than the absolute.

Age of patient.—Tables and charts are given illustrating 412 cases.

He says:

"Sarcoma of the uterus occurs:

Sometimes in young infants.

Very exceptionally during the second childhood (5 to 15 years).

More frequently as sexual functions are developed.

Less immediately after this.

Increase constantly from 25 years to the menopause, and then progressively grows less.

Most frequent—

1st. When sexual function is stopping.

2d. When sexual function is beginning.

He speaks particularly of the peculiar infantile forms of uterine sarcoma, and of their relation to Cohnheim's theory.

Pathological Anatomy of Sarcoma of the Body.

"Like epithelioma, sarcoma of the uterus should be divided into

"1. Sarcoma of the body.

"2. Sarcoma of the neck.

"From our statistics sarcoma of the neck is five times more rare than that of the body."

He continues the subject of sarcoma of the body under two heads:

I. Sarcoma of the parenchyma.
II. Sarcoma of the mucosa.

I. Of the parenchyma:

Of the 325 cases, 174 were of the parenchyma and 151 of the mucosa. "This is of relative value only for it is often difficult to differentiate."

Sarcoma of the parenchyma may be diffuse or circumscribed.

Of the diffuse variety he says: Very rare—10 cases only in literature—characterized by a considerable hypertrophy of the whole uterus; keeps the general form of the uterus resembling a gravid uterus; the vessels are dilated; enlargement of the uterine cavity and muscular hypertrophy. Upon section the uterine wall is very thick, softer than normal, often very friable, and is reddish in color. Histological formation almost exclusively of sarcomatous elements with thickened muscular fibers scattered throughout. Most authors think that the diffuse infiltration of the uterine parenchyma is due to a proliferation of cells surrounding the blood-vessels; connective tissue cells lying between the muscular fibers. Senn is quoted as holding that there is no primary sarcoma of the parenchyma, but that the tumor develops at the expense of the deeper muscular layers and infiltrates secondarily the uterine wall-cases in which have been found a large number of sarcomatous nodules are spoken of.

Of circumscribed sarcoma "which make up nearly all sarcomata of the parenchyma" he reports in detail 7 cases of his own, giving several illustrations of the gross and histological structure, and then says: Sarcoma of the parenchyma being very like fibromyoma, can be distinguished as

Interstitial.
Subperitoneal.
Submucous.

The development, gross, and microscopical appearance of each form are described. The relative frequency of the three forms, he says, is difficult to determine. His findings are

63.	Submucous sarcomata	37%
30.	Polypoid.	
33.	Sessile.	
60.	Interstitial,	35%
45.	Subperitoneal,	26%
22	with pedicle.	

The size of parenchymatous sarcoma is very variable—at times enormous. Consistence is very variable and irregular, but usually less firm than that of fibroma. Cross-sections are described and comparison is made with those cases which start as a fibroma. The degeneration of the fibromata usually starts in the center, rarely at the periphery of the tumor. The frequently occurring cystic cavities are described, and some twenty references given of the cases. Their mode of formation is considered.

The histology of such tumors is then taken up. "Sarcoma of the parenchyma of the uterus is essentially made up of embryonal cells which revert to fusiform, round, or giant types."

As to the relative frequency of these types he quotes the widely differing statistics, and then gives his own figures as follows:

In 58 cases of fibrosarcomata:
- 26 were fusiform.
- 12 were round.
- 20 were both fusiform and round.

Of 44 cases of sarcoma of parenchyma:
- 16 were fusiform.
- 14 were round.
- 14 were mixed.

Of all 102 cases:
- 42 were fusiform.
- 34 were mixed.
- 26 were round.

"Giant cells are rare in sarcoma of parenchyma." A case is described and illustrated, and other references given; 28 cases in all he finds. All the different kinds of cells are carefully described. The giant cells are characterized by the central location of the nuclei in contrast to tuberculosis. The intracellular substance and vessels are minutely described. Also cases of "Sarcomes lymphangiectasiques" are referred to. The "fibres lisses" representing "les restes du myome primitif ou de la musculature utérine" are discussed also. The cartilaginous tissue, which is found with relative frequency in sarcoma of the neck, is mentioned as being twice found in sarcoma of the parenchyma.

Cases of the presence of striated muscular fibers are referred to.

Referring to the different degenerations, he speaks of myxomatous as the most frequent, and thinks a number of cases given as such to have really been cases of conjestion and œdematous infiltration of the tumor.

"Sarcoma of the uterus usually remains for a long time localized completely, but almost always at a certain time in its evolution it extends to neighboring organs or to distant ones by metastases."

Local invasion most frequent in subperitoneal cases.

Pelvic peritoneal nodular involvement has been noticed several times.

Four cases of bladder invasion have been reported.

Invasion of the intestine is more frequent; of the tubes is rare (2 cases); 10 cases of secondary involvement of the ovary; 4 cases of abdominal wall invasion; and several cases of metastases in the vaginal walls are referred to.

The relative frequence of "distant" metastases is shown by a table—the most frequent localities being the lungs, liver, and intestines.

Although it is true that the metastases occur by means of the blood-vessels, cases have shown that the sarcoma may be spread by lymphatics.

II. Of the mucosa of the body.

There are two forms:

1. Circumscribed.
2. Diffuse.

Of 151 cases we have collected

97 were circumscribed.
54 were diffuse.

1. The circumscribed form
   a. Polypoid.
   b. As an intra-parietal tumor.

(a) Of the polypoid variety, he says many cases have been described, and he gives an additional one.

The method of development is described as being in almost all points comparable with that of fibrous polyps. The histological structure is taken up in detail. "The periphery of the tumor is never covered by a capsule."

The condition of the rest of the mucous membrane of the uterus is described, and the fact that there is more or less infiltration beyond the base of the tumor pedicle is emphasized as arguing against the simple removal at this point.

(b) Of the "Sarcome intra-pariétal d'origine Muqueuse," he says:

"This variety of sarcoma—one which is circumscribed and invades the uterine wall from the mucosa—has not been emphasized by the authors, but its existence is undeniable, as shown by several instances. It is quite frequent, though recognized with difficulty if not seen at the beginning of its development." Its development, and the changes in the uterus about it, are described, and the cases illustrating it are referred to. Cases where myomata have been invaded by the tumor are also given. Six cases in which the sarcoma of the mucosa has caused inversion of the uterus are reported, two of which were exceptional in that they occurred in nullipara.

"Sarcoma of the mucosa with parietal development has a remarkable tendency to infiltrate the whole thickness of the uterine wall so that it appears at the external surface of the organ." Nine cases referred to.

Consequences are variable, as follows:

1. Invades the peritoneum and neighboring organs.
2. As it invades the wall, it at the same time "destroys itself," and causing a perforation, allows the uterine contents to escape into the peritoneum.
3. The perforation is so rapid that no adhesions are formed, and a fatal peritonitis follows.
4. More often there is a peritonitis and adhesions are formed between the uterus and viscera, or even the abdominal wall.

2 Diffuse Sarcoma of the Mucosa.

He is careful to separate sarcoma of the neck from that of the body, and with this limitation he has collected 54 cases of diffuse sarcoma of the mucous membrane, in 33 of which the whole body mucosa was involved, and in 21 cases the invasion was only of a large part of the mucosa, which was almost always at the fundus.

The gross form of such a tumor is described as regular, round, or ovoid. On cut section two layers can be distinguished. (a) Outer, showing the characteristics of normal uterine muscle; (b) Inner, more or less thickened and made up of a whitish gray tissue with medullary appearance, soft and friable.

Size of such tumors is very variable, but they never attain the enormous size that sarcoma of the parenchyma does, and in contrast to the latter, nodules are not found, but the uterus is distended regularly.

The tumor is covered by the peritoneum, and usually there are no adhesions to neighboring

organs, except when far advanced, as illustrated by definite cases. The uterine vessels usually are enlarged. The muscular wall, as a rule, completely surrounds the tumor mass, and is hypertrophied, especially at the lower part. Sometimes in the aged the musculature is thinned out. At times cysts are present. The histology of the tumor mass is then considered carefully. "The neoplastic tissue is, as a rule, very distinct from the muscular layer—separated by a loose layer of connective tissue which can be easily detached without which there is never invasion of muscular tissue by sarcomatous cells." "On the contrary, invasion of the muscular tissue by the neoplasm has been proved true in some cases. This is shown by careful histological examination. Therefore diffuse sarcoma of the mucosa always has a tendency to develop on the side of the uterine cavity, but invasion of the wall is not exceptional. This invasion may exist from the beginning, and consequently even the most careful curettage may leave behind sarcomatous cells, and a rapid recurrence follows." The internal surface of the growth is described as rough and irregular, and at times polyps and large vegetations are formed, and an ulcerating form may result, as the vegetations are cast off, attended by a marked discharge.

The sarcomatous growth quickly obliterates the tubal openings—at times the tubes are involved, even to the peritoneum. "It is exceptional to see a body sarcoma invade the neck and it is difficult to prove the coexistence of body and neck sarcoma."

The cervical canal may be much contracted by vegetation, can be obliterated by it. Eight cases of hæmatometra and three cases of pyometra he has collected. Large quantity of liquid is found at times.

Generalization and Metastases of Sarcoma of the Mucosa.

"Remarkable tendency to remain localized" is the usual opinion, but this is exaggerated. Gefsner says there are metastases in 25% of the cases. The author is sure they do not occur until late. A table follows showing the different parts of the body invaded and the relative frequency. The lungs, peritoneum, lymphatics, and intestines are the more frequent.

"In almost all cases where there were metastases local invasion of cellular tissue about the uterus and of the peritoneum was present. Invasion of the viscera about the uterus is rare."

Histology of Sarcoma of Uterine Mucosa.

"Sarcoma of the uterus always presents the same histologic characteristics, whether it is circumscribed or diffuse."

One form can recur as the other form.

The cells are described and the author's own figures are given, which do not agree with others.

"In more than half of the cases of sarcoma of the uterine mucosa are found mixed cells, and fusiform are more frequent than round cell forms, whereas, in 20 cases of diffuse sarcoma there were 11 cases of round cells, 8 of mixed, and 1 of fusiform."

In circumscribed sarcoma the fusiform cells were the more frequent.

Gefsner says "there is not a single authentic case of mucous sarcoma formed exclusively of fusiform cells." The author does not agree with this, but believes that a good many of those cases described as mixed are made up of fusiform cells which have been irregularly cut in the sections.

"Giant cells seem rare in sarcoma of the mucosa"—16 cases are reported. "These cells are often not discovered." The intercellular substance and vessels are described.

In sarcoma of the mucosa, especially of the diffuse form, we can distinguish three zones—in the center is typical sarcomatous tissue; the external is the union of the sarcomatous tissue and the uterine wall; the internal is formed by œdematous sarcomatous tissue inclosing numerous vessels and areas of hemorrhagic infiltration. Often the tissue at the uterine cavity forms a sphacelus, in which almost nothing can be distinguished.

The formation of adeno sarcoma is described. As to the *degenerations of such sarcomata*, he says: Myxomatous is most frequent—probably often confused with œdematous infiltration.

Angeomatous changes result from over-development of vessels.

Lympho sarcoma of the uterine mucosa is very rare.

Some cases of cysto sarcoma have been reported.

Two cases of cartilaginous degeneration are given—one diffuse and one circumscribed.

Melano sarcoma cases are quite frequent—6 cases.

ABSTRACTS OF CURRENT LITERATURE

DEPARTMENT OF OBSTETRICS

UNDER THE CHARGE OF

C. S. Bacon, M. D. Rudolph W. Holmes, M. D.

C. v. Bachellé, M. D.

Has the Preliminary Vaginal Douche an Influence on the Morbidity of the Lying-in Period? Ahlfeld, F. (*Zeitschrift für Geb. und Gyn.*, Vol. LIV, No. 1, p. 145.)

Ahlfeld has made a careful study of the statistics of the lying-in patients to ascertain the effect of ante-partum vaginal douches. He found that for a period in 1891–92 the douche was considered unnecessary, so dispensed with, with the result of having a marked increase of the morbidity rate. A temperature of 38° or over was arbitrarily held the lower limit of morbidity. The following figures tend to prove his contention:

In 7,000 puerperal women, 662 patients in each thousand were fever free; i. e., under 38°.

In the first 5,000 cases, 646 patients in each thousand were fever free.

In the last 2,000 cases, 698 patients in each thousand were fever free.

In the period when the douche was dispensed with, there were 700 cases with 527 patients per thousand who were fever free, an increase of 15% over the average for the remaining 6,300 cases. As soon as the douche was again introduced, the results improved.

There always has been a lowered rate of morbidity among the operative cases (inductions of labor, forceps, versions, manual removal of the placenta) than in the non-operative cases, which he ascribes to the fact that an additional douche was employed at the time of the operation. Finally, he found that in those cases of streptococcic contaminations of the vagina the colonies were greatly reduced in number a couple of hours after the vaginal douche. For the three reasons; the fact that the morbidity rate increased when the douche was not employed, that operative cases showed a lower rate of morbidity, and that the colonies were fewer in number, makes him conclude the douche should be employed as a routine practice. He uses "Seifen-Kresol" 3%.

Cæsarean Section for Placenta Previa an Improper Procedure. Holmes, R. W. (*Journal of the American Medical Association*, May 20, 1905.)

This paper shows the impropriety of comparing the mortalities of cæsarean section for pelvic indications and for that of placenta previa, for in the former the case is uncomplicated, while the latter is almost always seriously compromised by hemorrhages. Extensive statistics are presented showing the mortalities of cæsarean section, of placenta previa treated obstetrically, and of placenta previa treated surgically.

The general mortality of cæsarean section has been underestimated. Too often a writer only reports his successful cases, or by a dubious method of exclusion, omits those cases which died on account of a real or imagined array of unfavorable circumstances; if the women recover these unfavorable circumstances are not mentioned. In 1,257 cæsarean sections, the maternal mortality was 12.1%; the mortality of 556 conservative sections was 13.3%; and the death rate of 280 Porro operations was 14.6%. The collective fetal mortality in 869 cases was 10.7%.

The Mortality of Placenta Previa.—The reputed high maternal mortality in placenta previa is not due so much to the lack of certain, definite procedures, but rather to the absence of proper skill, which only can come from practice, the lack of trained assistants, the half-hearted, procrastinating methods, to slovenly and careless regard to surgical cleanliness, and finally to the neglect to have an ample armamentarium at hand. If definite surgical principles were applied to obstetric cases, the mortality would be infinitely lower. The statistics of Read and Müller are quoted, showing that in the preantiseptic period the mortality never reached the appaling figure stated by Lawson Tait, of 50%, which was his unfortunate success, due to the fact that he never had experience in obstetric technic.

Read and Müller had collected 1,975 placenta

previas, during the period between 1861 and 1877; 466 died, a percentage of 23.6. Of 3,234 children 2,043 died—63.1%. Since the antiseptic days the writer collected 1,756 placenta previas, of which 213 women died, 7.36%. The fetal mortality was 54.1% in 1,985 cases. For valid comparison, the mortality of placenta previa in antiseptic days should be compared with the results of cæsarean section for this indication. We find that there were 25 cases of placenta previa treated by cæsarean section; of these 5 died, 20%, while 9 babies (36%), were born dead, and 16 (64%), were dead before two weeks were up. This is in sharp contrast to the maternal and fetal mortalities of the obstetrically treated cases, which was 7.36%, and 54.1%. This shows that practically for each baby saved by the surgical procedure, a mother is needlessly sacrificed.

The objections to cæsarean section for placenta previa are the following: *The child.* The life expectancy of a child is small in comparison to that of the mother; a new-born child has the same chance of reaching the age of 20 as a woman of 55 of living to the age of 77.5. In placenta previa the child is nearly always premature, is almost always born asphyxiated (if born alive); therefore its chances are poor for life.

The fact that placenta in previa is situated in the *lower uterine segment* generally means an aberrant third stage; for example, adherent placenta, postpartum hemorrhage from inability of the segment to retract from its histologic structure.

Absence of Facilities for a Laparotomy.—Cæsarean sections may best be done when the woman is in good condition. Hurried, make-shift preparations for a laparotomy always mean a neglect of detail which means jeopardizing the patient's life; as placenta previas are unexpectedly met with adequate preparation will not be possible unless there be protracted delays.

Rarely can the Operation be a Primary Procedure.—Rigidity of the cervix may be an indication for a cæsarean section in the presence of a previa, but it is shown that in 606 cases of modern writers not one instance of rigid os was found. As os never can be diagnosed to be rigid unless attempts are made to dilate it. The fact that attempts at dilatation have been made at once would make the case an unfavorable one; for a cæsarean section to be carried out at an ideal time must have had no preliminary vaginal manipulations.

The Infection. The fact that the placental site is situated in the lower segment, and therefore in close juxtaposition to the infective vagina, makes the woman with placenta previa peculiarly liable to infection. Further, a cervical infection, on account of the venous and rich lymphatic supply, is more dangerous than a pure fundal sepsis.

ANALYSIS OF REPORTED CASES

The operators who have delivered placenta previas by cæsarean have been general practitioners, surgeons, and gynecologists who candidly admit they know little or nothing about obstetrics, as Lawson Tait, who declares he never has had an obstetric experience, yet treated 14 placenta previas in consultation with the 50% mortality—to escape this he tried a cæsarean section. Likewise, Deaver did the section in his case because he did not know how to do a version. Lanphear and R. T. Morris did hysterectomies for miscarriage at the fourth and fifth months because there was bleeding from placenta previa (?).

The fetal mortality has been reduced 35%, but the maternal mortality has been raised threefold. There were 9 placenta previa centrales with one death, 11.1%, and 9 incomplete cases with 2 deaths, 22.2%. Conservative sections were performed 20 times with 5 deaths, 25%. The 5 Porros had no fatalities among them.

The operators of these 25 cases were 9 obstetricians, 5 surgeons, 5 general practitioners, and 4 gynæcologists. With one exception the obstetricians operated on account of complications, as contracted pelves, rupture of the uterus, atony with infection, etc. On the other hand, the others had no obstetric reason for the operation, with the exception of one or two instances.

The Conclusions.—1. Cæsarean section for placenta previa lowers the fetal mortality 30%, and raises the maternal death rate threefold. Approximately the life of one mother is taken to save the uncertain existence of one baby.

2. Unquestionably some maternal and fetal deaths have been suppressed, as in cæsarean section for pelvic indications.

3. A rigid os is one of the rarest complications of placenta previa. Undoubtedly most cases of so-called rigid os are simply instances of cervices unprepared for dilatation, or a misconception based on too brusque and rapid attempts to dilate or to extract. A true cicatricial cervix, and cervices of old primiparæ, may offer an indication for cæsarean section for placenta previa.

4. Pelvic contractions are indications for cæsarean section in the presence of previal hemorrhage; the pelvic contraction, not the previa, is the determining indication. The earlier the interruption of the pregnancy, cæteris paribus, the more may pelvic deformity be disregarded.

5. In general, the presence of a placenta previa will not be recognized before hemorrhages appear.

6. Cæsarean section for placenta previa never will have so low a maternal mortality as when performed for pelvic indications. Repeated examinations by the physician and his consultants must be made for diagnostic purposes; often a vaginal tampon must be introduced as a temporizing measure, at least until the woman may be transported to the hospital, or preparations made at home for a laparotomy. The acute anæmia, and finally the anatomic conditions post-partum all render the operation a peculiarly dangerous one.

7. Placenta previa cases appropriate for cæsarean section generally will demand the procedure irrespective of the fetal condition, as the primal motive should be to save the mother.

8. Cæsarean section for placenta previa should only be considered a *dernier ressort*.

9. If an abdominal operation is forced on the obstetrician, he should remove the uterus as a prophylactic against hemorrhage and infection.

10. The profession should await the adjudication of the field for cæsarean section in placenta previa by obstetric authorities before resorting to the operation.

THE INDICATIONS AND TECHNIC OF CÆSAREAN SECTION. Dauber, H. (*Zeitschrift für Geb. und Gyn.*, LIV, No. 2 pp. 282–293.)

Hofmeier's clinic has had 30 cæsarean sections in 15 years—1 case in 251 labors. Of the 30 cases 16 were of the conservative operation, and 14 Porro's, or modifications of his method. In 6 cases the typical Porro was employed; in 8 the sub-peritoneal method was used. Contracted pelves indicated the operation 26 times, 86%. Of these 26 cases, rachitis was the determining factor in 15, osteomalacia 10, and a Naegele pelvis in 1. Then myomata were the indications in 3, and eclampsia in 1.

He believes those cases which formerly were treated by induction of premature labor, now may be better handled by conservative section. He considers that the justifiability of cæsarean section is not so easily determined in primiparæ or multiparæ who have had living children, as in the instance of multiparæ who have had dead babies after difficult labors. In many of their cases the operation was determined on by the pressing wish of the women for babies, when other procedures did not offer such sure prognosis.

The uterus should be removed under these circumstances:

1. Infection of the uterus.

2. If myomata should demand the probable later removal of the uterus.

3. In osteomalacia as a therapeutic measure.

4. In severely ill women whose lives would be jeopardized by later pregnancies.

5. Atonic bleeding following conservative operations.

In the technic he recommends the routine eventration of the uterus before the uterine incision is made; the danger of contaminating the peritoneum when the uterus is opened in situ is real. He considers the longitudinal incision is the best. As the placenta was found 7 times in part or fully located on the fundus, and as in two instances of Fritsch incision the bleeding was profuse, he does not believe there is an advantage in the Fritsch incision. The uterine incision has silk retention sutures—the rest being sewed with catgut. The rubber ligature is reserved for the hysterectomies. Labor is not awaited.

CONCERNING THE ANATOMY OF LATERAL SYMPHYSEOTOMY (PUBEOTOMY). Tandler, J. (*Centralblatt für Gynækologie*, No. 28, 1905.)

Tandler has made an extensive study of the anatomical changes produced by lateral symphyseotomy, and the structures injured in the operation. The paper is so replete with anatomic details that an abstract is well nigh impossible.

He states lateral symphyseotomy means a loss of a valuable support to the vagina as ligamentum arcuatum and transversum, to which are attached the fibers of the transversus perinei profundus, are torn away; this circumstance possibly explains why the vagina is sometimes torn. The urethra does not loose its support behind the symphysis, therefore the operation is in sharp contrast to the median symphyseotomy. He further considers that the injury of the transversus perinei and levator ani predisposes to uterine prolapse. The corpus cavernosum is necessarily injured by the operation; whether it bleeds or not is not a question for him to answer—his is merely an anatomic discussion. In two pelves he found that the conjugata vera was increased .4 and .5 cm. when the bones were separated 2 cm., and in one instance .7 cm. when the space was increased to 4 cm.; the transverse was increased .8 cm. in two instances, where the separation was 4 cm. the diameter was increased 1.6 cm. He found that the side upon which the section was made gave a greater gain in the diagonal than in the other diagonal, due to the fact that the sacroiliac joint gave more on the same side than on the other—therefore an artificial distortion was produced simulating a Naegele pelvis. He recommends that the pubeotomy be done on the side upon which the biparietal diameter of the head lies, since the widening is greater upon the side which has the section.

REVIEWS

GYNAKOLOGISCHE DIAGNOSTIK. By Dr. Max Henkel, Oberarzt at the Royal University, Frauenklinik; Privatdozent at the University of Berlin. Berlin, 1905, Verleg von S. Karger.

German literature possesses several books on gynæcological diagnosis, but most of them are written rather for the gynæcologist than the practitioner. As the author states in the preface, his book is the result of lectures with the abundant material of the dispensary, held before students and practitioners at the Berlin Frauenklinik. Gynæcology reviewed with the wide scope of the general clinician and pathologist, and not from the narrow sphere of the specialist, is, in my opinion, the distinguishing and superior feature of Henkel's book. All the pathological subtleties which are the natural consequence of the development of gynæcological pathology as a special branch of pathology, are justly omitted, only essential and generally recognized facts are given. Only a few of the great number of interesting and also new points in gynæcological diagnosis can be mentioned here.

The American reader will be surprised at the extensive use made of the uterine probe as diagnostic and therapeutic means in retroflexio uteri, while its employment in submucous myomata and endometritis is limited by the author. Examination under anæsthesia is highly recommended in difficult cases. Contrary to Olshausen's teaching, vaginal exploratory puncture, cautiously performed, is advised by Henkel, to differentiate at times between pyosalpinx and myoma; he likewise recommends it in doubtful cases of extrauterine pregnancy (a two-edged diagnostic procedure in the hands of the practitioner). The author claims he never saw any bad results from it, whereas, he justly rejects curettage in ectopic pregnancy.

One has to be thankful to the writer for finally ending the confusion existing among gynæcologists in regard to the significance of carcinoma of the portio and cervix, which is due to the geographic denomination of the carcinoma generally used.

Portio-carcinomata are built up from squamous epithelium, the only exception is the "ulcus rodens" originating in an erosion. Twice as much space is justly devoted to the diagnosis of carcinoma as to that of endometritis. We fully agree with the writer in rejecting the use of all kinds of forceps-instruments, very popular among gynæcologists to perform an explorative excision of the portio, it ought to comprise suspicious and sound tissue in order to enable an exact histological diagnosis.

Special care has been applied in the chapter treating of the diagnosis of carcinoma of the cervix. As the specter of endometritis senilis has lately appeared again, every gynæcologist will heartily agree with the author when he says "that in hemorrhage during the menopause the conscientious physician has to furnish direct proof for the nonexistence of a cancer of the uterus before treatment is installed." The presence of a malignant growth of the ovary must also be considered.

Henkel's book is one of the very few which gives the reader a clear definition of the chorioepithelioma malignum which differentiates between the harmless proliferating chorioepithelium and the malignant growth penetrating into the muscles.

From the "Adenomyomata" proper is separated a "Adenometritis" caused by excessive invasion into the muscles by the glands of the mucosa. A successful attempt is made to differentiate the adenomyoma clinically.

Somewhat reassuring sounds the report from Olshausen's clinic, that only in one-half per cent of all operated myomata, sarcomatous degeneration is to be found, operative frequency of myoma is 18 per cent. Cystic degeneration of the ovaries is not recognized as idiopathic disease. They represent mere retention cysts and the complaints caused by them are attributed to pressure and increased weight.

The author has succeeded remarkably well to present dry scientific facts in such an agreeable form; written in captivating, yet clear and precise style, without any schematization, it reads more like an interesting novel than a medical text-book. On 256 pages are given to the practitioner as well as to the specialist, the essentials of Gynæcological Diagnosis, clinical as well as histopathological in a modern, scientific, but also intuitive, way. Henkel's book will soon make many friends and will be of great service to all those who prefer an exact diagnosis to an exploratory operation. The sixty-six original drawings and illustrations will satisfy even a fastidious reader.

G. SCHMAUCH, M. D.,
Chicago.

TREATISE ON ORTHOPEDIC SURGERY. By Edward H. Bradford, M.D., and Robert W. Lovett, M.D. Third edition. Wm. Wood & Co.

In bringing out this new (third) edition of their treatise on Orthopedic Surgery, the authors have practically produced a new work. To begin with, the very notable progress in some branches of this specialty in the past six years has necessitated rewriting a large part of the book. The chapters on "Non-tuberculous Diseases of the Joints," and particularly those dealing with "Arthritis Deformans," "Coxa-vara and Congenital Dislocation of the Hip,"are practically new, and contain the results of the active work of many others beside the authors, and add much to the value of the book.

Those who have been acquainted with the original work being done by Lovett in the "Etiology and Treatment of Scoliosis," during the past five years, will be glad to find the results and conclusions given in detail in the new chapter on that subject. The illustrations are largely new, and from photographs instead of drawings, and add greatly to the value and interest. The classification and arrangement of subjects has been changed, to the advantage of the practitioner and those who use the work for reference. The addition of a chapter on the details of various useful orthopedic apparatus, with directions for measurements and making, will be appreciated by the practitioners who like to treat their own cases, but are not familar with the mechanical technic.

The use of heavier and better paper and entirely new typography have greatly improved the appearance of the book. J. L. PORTER, M. D.

DIET IN HEALTH AND DISEASE. By Julius Friedenwald, M.D., Clinical Professor of Diseases of the Stomach, College of Physicians and Surgeons, Baltimore; and John Ruhräh, M.D., Clinical Professor of Diseases of Children, College of Physicians and Surgeons, Baltimore. W. B. Saunders & Company, Philadelphia, 1905.

The authors have set themselves the task of preparing an entirely practical book—one that fulfills the needs of the general practitioner, hospital interne, and medical student. They have unquestionably succeeded in accomplishing their object. A very large bulk of material is gathered together within the comparatively small compass of this book, and is arranged in concise and easily accessible form. The authors have wisely omitted much of the theoretical and imperfectly assimilated material which encumbers the subject in the present transitory stage of its development. The principles of dietetics are considered at not too great length, the greater part of the book being wisely devoted to the feeding of the sick. Citation from authorities is free and explicit, and numerous tables of foods, their chemical composition and nutritive values, are interspersed throughout the text. The chapter on the dietetic treatment of digestive disorders is to be especially commended. We note the fact that no mention is made of treatment by hypochlorization. At this time, when salt restriction is being extended with benefit to the treatment of a wide range of morbid processes, failure to mention and describe the procedure constitutes a glaring omission. We observe as well, absence of any reference to the influence of foods and feeding on blood pressure, and also the lack of any description of the newer methods for the dietetic treatment of Graves's disease.

The chapter on the dietetic management of surgical cases is more comprehensive and explicit than is usual in works of this class, and enhances materially the value of the book. A very complete list of school, hospital, and prison dietaries is given.

ARTHUR R. ELLIOTT, M. D.